SCIENTIFIC AMERICAN

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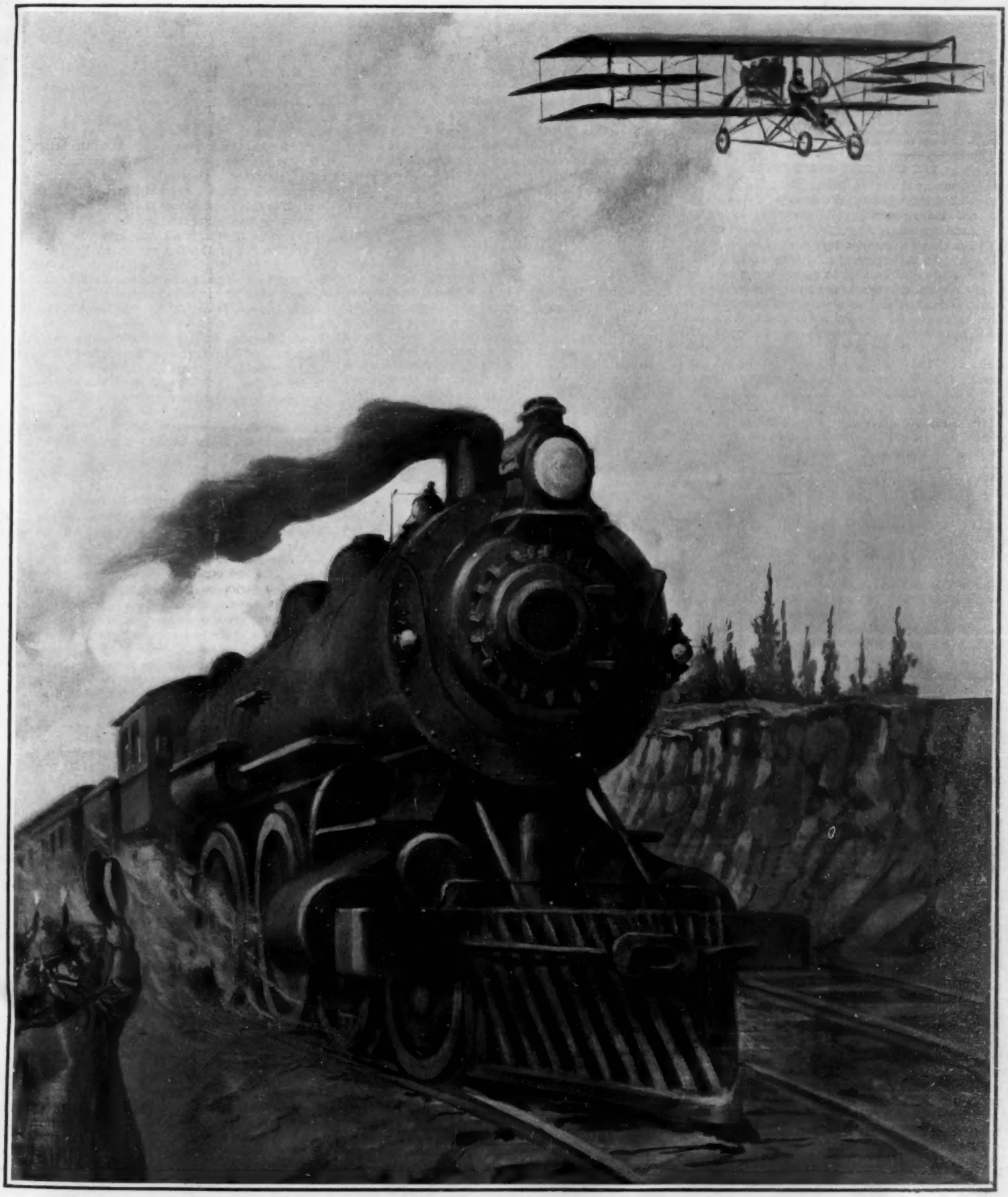

Hamilton's biplane traveling above and beside the locomotive of the special train during his flight from New York to Philadelphia and return on June 13th.

THE LATEST FORM OF RACING.—[See page 521.]

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ESTABLISHED 1845

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NEW YORK, SATURDAY, JUNE 25th, 1910.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE OPEN DOOR OF AVIATION.

IN dissolving the injunction granted in favor of the Wright brothers against Curtiss, by Judge Hazel, and the similar injunction granted by Judge Hand against Paulhan, the Circuit Court of Appeals has simply followed a long-established precedent in patent law. As a general rule, preliminary injunctions are not countenanced in patent cases, even by lower tribunals. The reason is not far to seek. Rarely indeed is infringement so clearly established that a court is justified in restraining the manufacture and use of an invention before the question of patent validity is decided. The practice is in every way commendable. If preliminary injunctions were granted without entering into the question of validity, many an honest defendant's business would be crippled until, after years of litigation, his legal rights are clearly defined.

The hardship which results from too great a readiness on the part of a lower court to restrain an alleged infringer is excellently illustrated by this very injunction which the Wrights obtained against Curtiss and Paulhan. As a result of the interlocutory decrees of Judges Hand and Hazel the Wright brothers have controlled flying in this country for the last six months. Unless he filed a bond with the court, no aviator who used a machine equipped with ailerons or wing warping devices, operated in conjunction with a vertical rudder could make, sell, or fly his apparatus in this country. It is far from our intention to censure the Wright brothers for the attitude which they have taken. They are in every way justified in seeking to uphold their patents and in defending rights which, unestablished as they are as yet from a legal point of view, are nevertheless the fruit of painstaking experiments extending over years. Probably the counsel of the Wright brothers themselves were as much astonished by the willingness of Judges Hand and Hazel to grant injunctions against Curtiss and Paulhan as the patent profession at large. Curtiss at least was a successful aviator before the Wright brothers decided to cast aside all secrecy and to show the world what manner of machine was that of whose performances they had darkly hinted. Blériot, too, had been pluckily experimenting for some time before the Wrights flew in public. Curtiss was using hinged wing tips in his earlier machines, with which he made public flights antedating the open flights of the Wrights. It is astonishing that the lower court should have failed to find in these facts a sufficient conflict of evidence to deny the granting of an injunction.

With the reversal of the decision of the lower court by the Circuit Court of Appeals, the development of aviation in this country is now unhampered. Paulhan, Sommer, Blériot, De Lesseps, and the rest of that daring company of French aerial pilots, whose exploits enliven the press dispatches almost every day, are now at liberty to enter this country and fly without the fear of finding their hands and their machines tied by a sweeping injunction. Moreover, American inventors will have the opportunity of improving existing machines provided with wing-warping devices, without fear of incurring a fine for contempt of court. Much as we should like to see justice done to the Wrights, we cannot but feel that the reversal of an injunction granted contrary to established precedents will be viewed with satisfaction by every aeronaut.

THE SCIENTIFIC AMERICAN AERONAUTICAL TROPHY.

APART from the value which will attach to the SCIENTIFIC AMERICAN aeronautical trophy as indicating that its permanent owner has in three different years made the longest flight in the United States, the trophy will possess a strong historical and sentimental interest as being absolutely the first prize of any kind offered in America for the encouragement of the art of aviation.

In this respect the trophy must forever be unique among the countless cups and prizes which will be offered in increasing numbers during the years to come. Cups which are won year by year for certain special events and pass into the permanent ownership of the winner possess a value and interest which, however great at the time, must necessarily become local and personal as the years go by; but a trophy which carries the distinction of being the first to be offered in that early period of doubt and struggle which marks the inception of a great and difficult art such as that of flight through the air, must ever possess a value all its own, which will inevitably increase with the lapse of time.

In this connection, we wish to draw the attention of entrants for the forthcoming long-distance, cross-country flights, for which such generous prizes have been offered, to the fact that, upon their sending a letter of notification to the Aero Club of America, their flights will receive official recognition, and if the distance covered should be greater than the seventy to seventy-five miles (official distance now under consideration) flown by Mr. Curtiss between Albany and Poughkeepsie, that contestant, unless his record should be surpassed before the close of the year, will be the winner of the cup for the year 1910. There is no entrance fee or expense of any kind attached to such an entry, the sending of a letter similar to that by Mr. Curtiss, which was published in the SCIENTIFIC AMERICAN of June 11th, 1910, being all that is necessary.

We wish, moreover, to take this opportunity of correcting the rather widespread impression that the cup must be won three years in succession. As a matter of fact, there is no stipulation of this character laid down. If a contestant wins the cup three times, he becomes its permanent owner, whether it is won in successive years or in years separated by considerable intervals. As matters now stand, Mr. Curtiss's name is inscribed upon the cup as the winner for 1908 and 1909. So far, he has made the longest flight for 1910; but if, during the forthcoming races, some other contestant should exceed his figures and remain unbeaten at the close of the year, his name will be inscribed upon the cup for 1910; and two similar successes in future years would give him the trophy as a permanent possession. Had Mr. Hamilton made entry before his recent magnificent trip to Philadelphia and back, his 83-mile continuous cross-country flight would have constituted him the present holder of the cup for 1910.

It can readily be seen that the value of this prize will increase with the number of names that are inscribed upon it, and it is the sincere hope of the SCIENTIFIC AMERICAN, as it will be of all who are interested in this new and fascinating sport, that the entrants for this trophy may be many, and the contest marked by the keenest rivalry.

THE INTERNATIONAL UNION FOR CO-OPERATION IN SOLAR RESEARCH.

IF a scientific critic were called upon to mention one of the most striking and important features of modern astronomical research it is quite likely that he would refer to the spirit of organized and practical coöperation which is manifested by observatories and astronomers. By evolving suitable plans for joint efforts to enable each institution to do the work for which by equipment and position it is best suited, and by assigning through common agreement the particular part to be played in any given campaign, increased efficiency is secured, useless duplication is prevented and the entire project under prosecution can be advanced symmetrically and rapidly. The photographic charting of the heavens, the observation of transits and total solar eclipses, the study of the variation of latitude, and the investigation of the shape and mass of the earth, are a few familiar instances of valuable coöperative effort by astronomers.

More recently there has been an attempt to secure a similar harmony of effort and coöperation in the study of the sun, and in 1904 at the initiative of Prof. George E. Hale, director of the Mount Wilson Solar Observatory of the Carnegie Institution of Washington, there was formed among the visiting astronomers at the St. Louis Exposition an International Union for Coöperation in Solar Research. In the following year this Union met at Oxford, and in 1907 at the observatory of Meudon in France. This year, on August 29th, the members of the International Union will assemble at Mount Wilson, California, as the guests of Prof. Hale and the Solar Observatory of the Carnegie Institution. This meeting should prove unique and memorable, for it may be doubted whether there have ever been assembled so many eminent astronomers and astrophysicists interested in solar studies as those who have accepted the invitation for the Mount Wilson conference. That such a gathering is largely an appreciation of the important services to astronomical science of Prof. Hale and the observatory under his direction will be generally admitted, but at the same time these distinguished astronomers and physicists will be able to examine for themselves this interesting institution and its novel and powerful instruments by means of which several new chapters in our knowledge of solar phenomena have been written and still other discoveries, especially in the field of stellar evolution, seem destined to follow.

To most of the visiting scientists who never before have made the pilgrimage from Pasadena up the slopes of Mount Wilson the work of the Solar Observatory is familiar from accounts published in scientific periodicals. No one is more welcome before European astronomical societies than its distinguished director, who whenever abroad is always called upon to describe its progress. Therefore, it is not surprising that when the opportunity was afforded, some fifty representatives of important astronomical observatories and physical laboratories should decide to cross the Atlantic Ocean and the American continent to see and learn at first hand of work in which they are intimately interested. While it is a source of intense gratification to Americans that the Mount Wilson Observatory has become so pre-eminent in the brief space of some six years, yet it must be remembered that solar astronomy and astrophysics are prosecuted with vigor at other institutions and by numerous astronomers. It is this circumstance that makes of importance the coming meeting of the International Union.

The value of solar work may be appreciated when it is stated that the dry season at Kodaikanal in Southern India, where there is maintained a large observatory, corresponds with the rainy season at Mount Wilson, when of course the regular daily photographing of the sun is out of the question. With proper arrangements, therefore, it is possible to obtain a continuous photographic record of solar phenomena from one station or another on the earth's surface. Likewise the visual observation of the sun-spot spectra is definitely apportioned among various observers, so that each group receives a portion of the spectrum for thorough study, the results of the various observations being recorded on a common plan. Again, so important in modern solar research has become the use of spectroheliograph whereby the sun's surface or limb is photographed in light of a single wave-length, according to certain definite arrangements, that there is now an important chain of observatories from India across Europe and America to the Pacific Coast, where these instruments are in daily use. To record the amount of the sun's radiation received at the earth's surface, bolometers and other heat measuring devices are employed at various stations and continuous records are kept. In many cases it is quite obvious that local conditions may affect the observations and the records. Accordingly there must be simultaneous observations at a number of stations extending over as long periods of time as possible. These are being secured with ever greater efficiency by the members of the International Union for Coöperation in Solar Research. Such coöperative action is not intended to destroy initiative or originality in any observatory or astronomer, but rather to encourage it. To-day a large number of observers are engaged actively in solar research, and in no department of astronomy is a greater amount of progress being made. This is all the more striking as it was only a few years ago, to use Dr. E. E. Barnard's picturesque expression, that "the sun had almost been relegated to that limbo from which nothing new can ever come."

Some interesting communications relating to the general study of the earth were presented to the International Geodetic Association, which met in London in September, 1909. The values of the oblateness and the equatorial diameter which have been deduced from the triangulation established by the U. S. Coast and Geodetic Survey agree closely with the values obtained from European surveys. Prof. Eotvos exhibited a torsion balance which registers variations of the force of gravity more rapidly than the pendulum, and with equal accuracy. The experiments made by Dr. Hecker in the Indian Ocean confirm the generality of isostasis, i. e., increased density of the crust of the earth beneath depressions of the surface. Major Coningham has discovered one belt of more than normal density, lying beneath the Himalayas, and a second parallel belt south of that range. Hecker has also succeeded in protecting a horizontal pendulum from temperature variations sufficiently to detect an exceedingly small variation in gravity, having a period equal to one-half of a lunar day. The variation attains two-thirds of its theoretical amplitude and gives the earth, as a whole, a rigidity comparable with that of steel. The resistance to deformation is greater in an east and west than in a north and south direction. This difference is probably caused by the earth's rotation.

ENGINEERING.

The British government has placed a submarine bell off the Lizard. It is suspended from a heavy tripod, which was lowered to the bed of the ocean at a point about two miles from land. The bell is connected by cable with the lighthouse, from which it will be operated. It is anticipated that, since steamers passing up the Channel all approach the Lizard, the bell will be of great assistance to them, particularly in time of fog.

Very gratifying is the steady growth in efficiency of the successive submarines which are being tried out for the United States navy. The "Salmon," built at the Fore River yards and designed for 11 knots at the surface and 10 knots submerged, established last month a surface record of 13¾ knots, and a record below the surface of 12 3/10 knots. Four torpedoes, discharged when the ship was at full speed in the submerged condition, scored what was practically a series of bulls-eyes.

It is reported by the Engineering Agency of South Africa, Johannesburg, that an important body of iron ore has been found in Natal, within thirty miles of the railway and within seventy-five miles of the coast. Limestone has been located in large quantities at a distance of only a mile from the ore body, and coking coal has also been discovered in Natal. In view of the fact that the River Tegela, which is suitable for the development of hydro-electric power, runs through the iron ore property, it is likely that the new find will be turned to immediate commercial account.

The removal of the twelve-year-old, 20-story Gillender Building at Wall and Nassau Streets in this city is certainly a record in house-wrecking. The time allowed was 45 days at a price of $50,000, with a penalty of $500 for every day exceeding that period. The work will be done within the specified time. The most difficult work has been the removal of the brick backing of the outside stone work. The steel frame was taken down, piece by piece, by knocking off the heads of the rivets and driving the latter out with a drift pin. The steel work will be available for other construction.

The system of transmitting train orders in this country by the telephone is making rapid strides. Statistics filed by the Interstate Commerce Commission show that the telephone is being used for this purpose on 295 roads in the United States, on which 26,344 miles of road are operated by this method. On ten of the roads telephone dispatching covers 500 miles or more, and on five roads the distance covered exceeds 1,000 miles; this being the case on the Atchison, Topeka & Santa Fé; the Chicago, Burlington & Quincy; the Great Northern; the Illinois Central, and the Pennsylvania Railroad.

The Bergen tunnel under Jersey City Heights, through which for forty years all passenger trains on the Erie Railroad have been run, will be abandoned on July 1st for passenger service, and will be given over wholly to the movement of freight. After that date passenger trains will make use of a great open-air four-track cut, upon which the contractors have been at work for the past three years. The cut, which extends for 4,400 feet through the Heights, is 58 feet wide at the bottom, and varies from 45 to 85 feet in depth. It is intersected by four tunnels, where the material has been left in place to carry the streets above; but none of these is of greater length than an ordinary train.

In a recent fire test of the reinforced concrete floor of a tall building, the following excellent results were obtained. The floor panels measured 22 feet by 20 feet, center to center of the columns, and they were required to stand a test load of 200 pounds per square foot with a deflection not above three-quarters of an inch. In the test, the deflection under this load was only one-eighth of an inch. With a hot fire beneath the floor, there was an increased deflection of 1⅛ inches. Water from a fire hose was then directed against the bottom of the now heated concrete, when the floor rose seven-eighths of an inch, leaving one and one-quarter of an inch deflection. This test, it should be understood, was made of a floor in the completed building.

The New York, New Haven and Hartford Railroad have received from the Westinghouse Company a new single-phase electric locomotive for the high-speed passenger service between New York and Stamford, which is of double the capacity of those already in service on the New Haven road. The specifications called for a locomotive which could haul a 1,500-ton freight train at a speed of 35 miles an hour on level track, where the train resistance was not more than 6 pounds per ton. The locomotive was also to be capable of hauling an 800-ton passenger train at a speed of 45 miles per hour. In the tests, 37 loaded cars, a heavy freight engine and a caboose were drawn from New Rochelle to Stamford, a distance of 18 miles, in 27 minutes, the maximum speed attained being 49 miles an hour.

ELECTRICITY.

It has been proposed that the surplus water from the canal locks at Lockport be utilized to generate current which may be employed in lighting the Erie Canal from the Tonawandas to Albion. Surely the advantages such a system would offer would well repay the cost of installation and maintenance.

An electric cable has been laid in Oneida Lake connecting Frenchman's Island with the mainland. The distance is a little over a mile. The cable is to conduct current at 6,600 volts to the island, where it will be stepped down to 110 volts to be used for lighting the pavilions and amusement apparatus of the resort. This is said to be the first long-distance, high-tension submarine cable ever laid.

The United States Senate has passed the bill introduced by Senator Depew governing wireless telegraphy. It requires that all wireless stations secure licenses from the Department of Commerce and Labor. The bill aims to prevent interference of messages and the sending of false distress signals and gives the army and navy messages the priority over commercial messages.

For some years wireless telegraph experiments have been conducted by Dr. Frederick H. Millener for the Union Pacific Railroad. It is stated that the road is soon to establish a wireless telegraph system of communication with moving trains. Tall towers are to be erected at Sydney and Cheyenne, which will have a wide radius of communication. The system should be invaluable in the case of the interruption of wire service by storms.

Illustrative of the rapid improvement in metal lamp filaments is the recent decision of the Chicago Railway Company to install tantalum lamps on all new cars and cars that have to be rebuilt. Before arriving at this decision, a series of tests was conducted, extending over a period of six months. Lamps were installed on cars in regular service and accurate records were kept which demonstrated their efficiency for this class of work.

The Legislature of Massachusetts recently appointed a special commission to inquire into the cost of living. Among the various reports is one showing the difference in price of electricity in various cities of the State in the last twenty years. In practically every case the cost has been reduced very materially. In Boston, for instance, electricity cost from 20 to 60 cents per kilowatt hour in 1890, as against 11 cents at the present time. Taunton is the only city which shows no change, the price in 1890 and 1910 being 20 cents per kilowatt hour.

At the recent meeting of the National Electric Light Association in St. Louis, the committee on grounding of secondaries recommended that a rule be adopted requiring all circuits of under 150 volts to be grounded. Previously, the committee had recommended that circuits of higher voltage should also be grounded, but a canvass of a large number of central stations showed that the danger of a breakdown of transformers and the short circuiting of high potential lines would be greater than the chance of a shock from secondary of 230 to 300 volts. For this reason, the recommendation regarding circuits of more than 150 volts was withdrawn.

Now that the thunder storm season is here, the Denver City Tramway Company is instructing its employes in the safest method of running their cars during a storm. The motormen are ordered to let the cars coast as much as possible, so that in case of being struck by lightning, the vital apparatus of the car would not be so liable to injury. The motormen are also instructed to note, if possible, the position of the controller handle when the car is struck by lightning. If the current were off, the injury would probably be confined to the controller box. Otherwise it might damage the motors, or it might burn off the trolley wire at the base of the trolley pole. In the latter event, it would be necessary to have the car pushed back to the barns.

Paris time was transmitted some days ago from the Eiffel Tower by wireless telegraphy to all wireless stations and ships fitted with wireless apparatus within a radius of 2,500 and 3,000 miles. The time signals are to be continued and will be sent at midnight, and again at two minutes and four minutes after. The receipt of a signal will not enable a ship to determine its position or even its longitude, but will serve as a check on the chronometer. This test of wireless signaling for time at sea has brought up the question of the kind of error, in longitude, to which in these days of accurate navigation a ship is liable. An error accumulates with the time at sea and as all ships carry at least three chronometers, there should not after a lapse of 100 days be the least doubt of a ship's longitude—that is within a few seconds—but the number of time signals scattered over the world is now so large that every steamer has the opportunity of correcting its own chronometers more frequently than is here suggested.

SCIENCE.

Prof. E. E. Barnard informs us that on June 6th he obtained a very good photograph of Halley's comet. The plate showed the tail drifting off into space, and a new one forming in a different direction.

The collection of fresh-water sponges of the U. S. National Museum is now being critically examined by Dr. Nelson Annandale, superintendent of the Indian Museum in Calcutta, who is an accepted authority on this subject. Under the title of "Description of a New Species of Spongilla from China" there has just been issued paper No. 1737 of the Proceedings of the U. S. National Museum. In this publication Dr. Annandale describes as new *Spongilla* (*Stratospongilla*) *sinensis*, which appears to be allied to *Spongilla aspinosa* Potts, from which however it differs in its compact structure and lack of flesh spicules. This specimen was found on rocks in the canal in southern Kiang Su, near Shanghai, China. The type is in the collection of the U. S. National Museum.

Prof. Negro of the University of Boulogne, has studied the radio-activity of dew. The precipitation was made on glass plates exposed in immediate contact with the soil for several hours, beginning at about eight o'clock in the evening. It is interesting to note that the water vapor was deposited entirely on the surface turned toward the ground, while the opposite surface was quite free from any trace of moisture. From Negro's experiments it would seem that, as in the case of snow and rain, the activity of dew disappears almost entirely in a very short time, which may be placed at not much more than half an hour. The maximum radio-activity is detected not immediately after the introduction of the plates into an electro-static apparatus, but some minutes afterwards, in which respect it differs from snow and rain.

In one of the Leopoldshall workings a blower of inflammable gas has been issuing, at a depth of 1,500 feet, since August, 1904. The gas contains 82.6 per cent of hydrogen, 4.4 per cent of methane, and 12 of other gases, including neon and helium. The helium greatly preponderates over the neon, but the two together form about 0.17 per cent of the original gas, or nearly 1 per cent of the gas after removal of the hydrogen. The German chemist E. Erdmann has investigated this gas, and he calculates that at least 12 cubic meters of the above gases have escaped since the blower was tapped. He attributes the existence of the helium to the degradation of radium salts originally contained in the waters of the sea which furnished the deposits, and he regards the hydrogen as resulting from the radio-active decomposition of water, the equivalent oxygen having disappeared in converting ferrous into ferric salts in the carnallite.

Mr. Austin Hobart Clark, an accepted authority on crinoids, has recently published two papers in the Proceedings of the U. S. National Museum. The first of these papers, No. 1740, is "On the Origin of Certain Types of Crinoid Stems," and in which he discusses the probable relationship between the column of the crinoid and the central or sur-anal plate of the echinoid, and how widely different types of columns may be reduced logically to a primitive common ancestor. Among his conclusions from the evidence he presents is that the stems of the recent and most of the fossil crinoids may be derived by supposing them to be the homologue of the central plate of the crinoid-echinoid ancestor which has gradually become thickened and elongated and developed transverse alternating fractures which have metamorphosed into definite articulations. The second paper, No. 1743, bearing the title "A New Australian Crinoid," is a description of a new species which he calls *Compsometra lacertosa* and which was obtained at Port Jackson, New South Wales, by Mr. J. Bracebridge Wilson in the summer of 1887-88.

The late Prof. Garriott, of the U. S. Weather Bureau, was working at the time of his recent sudden death on a very promising method of long-range forecasting, based on the observation of departures from normal pressure in widely separated regions of the world. Telegraphic reports of the pressure at European and Asiatic stations are received every morning in Washington, and were utilized for this purpose. The study of "correlative meteorology"—i. e., the interrelations of atmospheric phenomena in parts of the world far remote from one another—is now occupying the serious attention of meteorologists in all countries, and is one of the two salient features in the recent development of their science; the other being the exploration of the atmosphere by means of kites and balloons. An international commission was recently organized, under the presidency of M. Léon Teisserenc de Bort, for the purpose of maintaining a world-wide telegraphic interchange of meteorological observations, so that in the future, if the plans of the commission can be realized, the forecaster will have at his disposal a daily weather map embracing the whole world, instead of a single country.

MODERN STEEL LOCK BAR PIPE CONSTRUCTION

BY FRANK C. PERKINS

In considering the use of steel pipe as compared with cast-iron pipe, it should be remembered that the value of water pipe depends on carrying capacity, strength and durability as well as cost. The accompanying illustration, Fig. 1, shows 48-inch lock bar pipe lying in a trench at Philadelphia, Pa., while the details of construction are noted in Fig. 2. It is held that the cost is about 5 per cent more than riveted pipe, but it has greater strength and carrying capacity.

It may be stated that this capacity depends on friction, and riveted pipe presents an obstruction at every rivet and every circular and longitudinal seam.

It is also claimed that the uniform section of the lock bar pipe without any obstruction of any kind from end to end of each length of pipe, materially reduces friction. Some engineers say the carrying capacity of lock bar pipe is from 10 to 15 per cent greater than riveted pipe or is equal to well-coated, well-laid iron pipe.

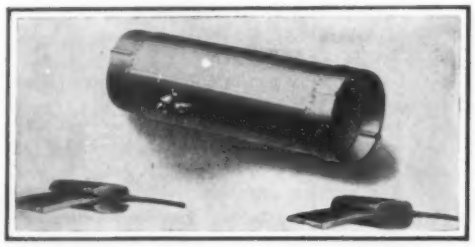
Tests on 30-inch pipe at Lockport, N. Y., in 1909, showed a friction loss less than that given by Watson's Tables for cast-iron pipe. It is well known that steel pipe is materially stronger than cast-iron pipe. During a cloudburst in 1903, two 48-inch riveted steel pipe lines carrying 50,000,000 gallons per day for Newark, N. J., were undermined and left unsupported for four days for over 35 feet, and in addition to the weight of the pipe and the water passing through them (about 15 tons), there were some thirty uprooted trees piled up over the pipe which supported this immense weight and pressure, without damage.

It is conceded that cast iron is brittle and treacherous at best and though apparently sound one day, may prove defective the next, and break without a moment's notice.

It is of course true that the strength of any steel pipe is equal to the strength of the joints. Single riveted joints have an efficiency of about 55 per cent, double riveted joints about 65 per cent, triple riveted double, buttstrap joints about 86 per cent, and welded joints about 90 per cent. Lock bar joints have an efficiency of 100 per cent, and have greater strength than plates themselves, as all tests result in a failure of the plate, without injury to the joint. A 42-inch diameter 7/16-inch plate lock bar pipe was tested to 1,050 pounds pressure, and the metal of the plate was stretched 4½ inches with neither injury to the lock bar joint nor the least leakage along the same. Further pressure was impossible, because of the blowing out of the riveted reinforcing pads at the inlet and the gage.

It is maintained that lock bar pipe is from 20 to 30 per cent stronger than riveted pipe and 10 per cent stronger than welded pipe, and experience has shown that the natural life of steel pipe when properly made and laid is fully equal to that of cast-iron pipe.

Without doubt the life of all metal is less than it was twenty years ago, as nowadays electrolysis, sulphurous acid, galvanic action and other agents greatly accelerate corrosion. It is therefore most difficult to compare the life of pipe laid within the last twenty years and pipe laid prior to that time, because of these constantly increasing corrosive influences.



Before closing. After closing.

Fig. 2.—LOCK BAR STEEL PIPE. TAPER JOINT.

Fig. 1.—LOCK BAR PIPE 48 INCHES DIAMETER IN TRENCH AT PHILADELPHIA, PA.

According to experiments on the reception of radiotelegraphic signals when transmitting with a spark gap in compressed air, as compared with signals received when an ordinary spark gap was used, there appears to be no advantage in using compressed air for this purpose. While the dielectric strength of the air is enormously increased, so also is the resistance to the oscillatory spark, both appearing to increase in about the same ratio.

THE WEARING QUALITIES OF MANGANESE STEEL

BY J. F. SPRINGER

Manganese steel is by no means a new material, but its application has been slow because of the difficulties which manifest themselves in giving its final form. It seems to have been discovered by Hadfield's Steel Foundry Company, Sheffield, England, some thirty or forty years ago, when seeking a hard and tough substitute for steel when used for castings. It was found that the mere increase of carbon in the steel did not have the desired effect. Steel having a carbon content as high as 2 per cent was unsuccessfully tried. It was known that when the manganese content of a steel somewhat exceeded 2.75 per cent, the alloy would be brittle. What was not known and what the Hadfield Company found out was that if the manganese were increased to a point ranging anywhere from 7 per cent to 20 per cent a steel might be produced which is remarkably strong and tough. Now this reversal of a leading property of an alloy by merely increasing the proportion of one of its constituents is, as R. A. Hadfield pointed out, not without precedent. In forming alloys of copper and tin, the resultant alloys seem to become harder and more brittle as the tin content rises from a low point up to a considerable percentage, say 35 per cent, but when more tin is present than the soft and tough copper, the alloy becomes softer.

It was early found, however, that manganese steel was a very refractory metal to machine. The properties of hardness and toughness produced a combination that was very successful in resisting the cutting edge of the tool. And this characteristic is, even today, a bar to the application of this metal. We have high-speed steels capable of enormous performance when used against the pure carbon steels and cast iron. But manganese steels still hold out. Almost the only practicable thing to do is to use the grinder. Now the grinding machine is of late become a strong competitor of the ordinary machine tool. But its development has hardly been carried far enough to enable it to handle commercially the multiplicity of cutting operations necessary to enable manganese steel to have a general application to all the purposes for which it is highly adapted. Further, it has been found difficult to roll.

But so great are the intrinsic capabilities of this material for certain uses that, in spite of the difficulties of giving it the desired form, it has been pretty rapidly acquiring friends. Consider, for example, the case of the Boston Elevated Railway Company. This corporation operates its transportation system on a track which makes a complete turn of 360 deg. about every mile and a half. In fact, more than 40 per cent of the line consists of turns and sinuosities. Eighteen curves are on radii less than 100 feet, and sixteen others have radii between 100 and 150 feet. Soon after operation began, those in charge became impressed with the fact that an enormous destruction of rails was taking place on the curves. This has been ascribed largely to the sharpness of the curves, and to the combination of grades and curves. It was on the curve of the Park Street south-bound track where the ordinary rail had a life of but about 44 days. The radius here is 82 feet. At the same locality, an open-hearth rail went out of service in even less time. At Adams Square, where there is a curve of 89 feet radius, a low-carbon Bessemer, an open-hearth, and a high-carbon Bessemer rail were all tried. The last was the only one which had even a moderate life—10½ months. Nickel steel was tried on a 100-foot curve at Haverhill Street. But its life was less than that of a high-carbon Bessemer rail at the same location, the two periods being 6 months 19 days and 11 months 13 days. Apparently, however, better results were obtained from nickel steel than this instance would indicate, as Mr. Steward, the roadmaster, regards the nickel-steel rails as comparing well with ordinary steel. The company tried manganese-steel rails as well. In one case, a nickel-steel rail was put in between two manganese-steel rails, with the result that after the lapse of 204 days it had to be taken out because of its failure to equal its companions. The center of the head had been worn down over ½ inch, while the corresponding position on a manganese-steel rail disclosed a reduction of but 3/16 inch. But perhaps a more striking example is that of a manganese-steel rail at the Park Street station, where the wear was the same in a period over four times as long. In fact, a manganese-steel rail laid on April 26th, 1902, showed loss from the top surface amounting to only about 9/16 inch after the lapse of 2,409 days. The accompanying engraving shows the Park Street curve.

An examination of Figs. 1 and 5 will show, however, that the edge, where the transition surface from cone to flange acted, suffered considerably. In fact, the corporation now protects the manganese-steel rail from side friction by means of a guard rail. It is probable that some, perhaps a large, part of the wear from the flange has been prevented. At any rate, Mr. Steward has expressed his opinion that the manganese-steel rail will not resist the flange action nearly so well as that of the cone.

Now, it should be observed, the manganese-steel

(*Concluded on page 527.*)

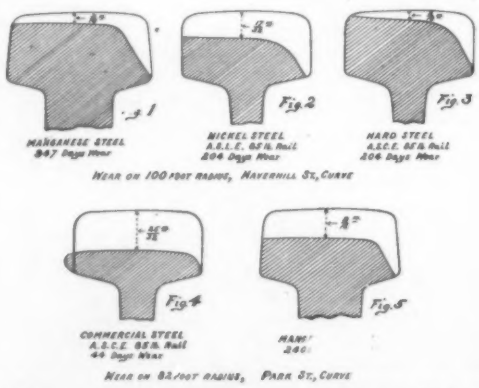


Diagram showing extraordinary wearing qualities of manganese steel rails.

This curve has the small radius of 82 feet.

THE PARK STREET CURVE OF THE BOSTON ELEVATED RAILWAY ON WHICH EXCESSIVE WEAR OF RAILS OCCURRED.

THE CONTAGIOUS DISEASES OF METALS

THE RESEARCHES OF PROF. ERNEST COHEN

It has been known for some time, and probably even in antiquity, that metals are subject to diseased conditions. Prof. Ernest Cohen's researches have thrown considerable light on this question and have demonstrated, moreover, the contagious nature of such diseases, that is to say, a piece of diseased metal has the power of infecting, by a sort of catalytic action, a piece of sound metal with which it is in contact.

TIN PEST.

In 1851 Erdmann, in a communication made to the Royal Society of Sciences at Leipsic, called attention to a peculiar structural modification of tin which he had observed in some old organ pipes. He attributed the change to the vibrations to which the metal had been subjected. In 1869 Fritzsche of St. Petersburg published observations of similar phenomena, and expressed the opinion that the alteration in the nature of the tin was due to the action of severe cold to which such tin had been exposed, and verified the correctness of this theory experimentally. Other investigators turned their attention to this subject, but the true nature of the modification and the exact conditions governing its appearance and development were not fully understood until they were determined by Prof. Cohen.

The disease studied by Erdmann and Fritzsche is designated by Prof. Cohen as tin pest. The metal thus affected swells in spots, forming wart-like blisters, from which small drops issue and hang suspended in very much the same manner that drops of quicksilver will adhere to polished copper coins. In the further progress of the disease, the blisters become larger and the metallic gloss disappears more and more. The interior of the mass is affected last, as can be shown by sawing through the metal whose surface has become quite dull. When the entire mass has been transformed, it crumbles readily, and consists partly of a granular powder similar to sand, and partly of more or less consistent fibrous lumps of all sizes up to that of a fist. When a piece of tin is cooled artificially, the modification appears first at isolated spots, from which it spreads in wart-like blisters and later forms a columnar structure.

Tin thus modified by the action of cold is distinctly gray; the application of heat produces a remarkable change. Even by merely covering it with hot water, the dark gray color is caused to become materially lighter, approaching that of ordinary tin. The change is due to the temperature exclusively. If a specimen of powdery modified tin is heated in a closed vessel by means of a water bath, it not only assumes a lighter color but decreases in volume quite perceptibly. If it is then cooled again below the freezing point of mercury, it again becomes almost as dark as it was before heating. If modified, tin is heated to fusion, an appreciable proportion will remain in the oxidized state. The molten portion will upon solidification assume the appearance of ordinary tin, and if cooled to a low temperature, it can be transformed again into the gray modification. Ordinary tin has a specific gravity of 7.28, but gray tin is considerably lighter, having a gravity of only 5.75.

Brass kettle corroded by the wrought metal disease.

Prof. Cohen directed his attention at first to determining the temperature at which ordinary tin is transformed into the gray modification, the results obtained by former investigators differing widely, some having found 35 deg. (Centigrade) as the critical point, others 100 deg., etc. Fritzsche's experiments indicating that the transformation was enantiotropic or reversible, it was to be expected that there would be a definite temperature at which the transformation might proceed in either direction.

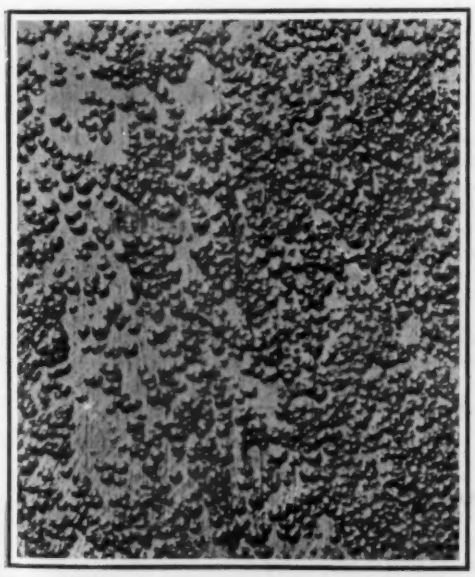
Prof. Cohen employed two independent methods for determining this critical temperature. One, an electrical method, consisted in bringing two separate bodies of gray tin into a vessel containing a 10 per cent solution of chlorostannate of ammonium. The two bodies of tin are connected with an apparatus permitting the experimenter to observe and measure any electromotive force arising in the cell. As long as both bodies are of the same temperature, there is no electromotive force. But if one of the tin bodies is given the temperature of boiling water, and the other that of cold water, the heated body is transformed into ordinary white tin, while the cooled body remains gray. The electromotive force manifested under these conditions was measured at different temperatures. At about 20 deg. C. the electromotive force was equal to zero, indicating that the critical temperature is in the neighborhood of 20 deg. C. Prof. Cohen also found that the presence of the chlorostannate of ammonium solution accelerated the transformation considerably, in both directions.

The other method was a volumetric one, based on the fact, stated above, that the two forms of tin have different specific gravity. The apparatus employed is very similar to an ordinary thermometer, except that the capillary tube is open at the top. The lower part of the bulb is filled with gray tin, the upper part and a portion of the capillary tube with a liquid inert relatively to tin, such as petroleum. The apparatus is heated to a temperature (say 25 deg. C.) a few degrees above the probable critical point, so that a portion of the gray tin is transformed into the white variety. Then the apparatus is kept for some time at a constant temperature of say 21 deg. C. and the behavior of the petroleum column is observed by means of the scale. After a few minutes, it will be found to have fallen a few millimeters, thus indicating that 21 deg. C. is still above the critical temperature, for as long as the formation of white tin continues, the mass of tin contracts in volume, owing to the greater specific gravity of white tin. The temperature being then kept constant for a time, say at 15 deg. C., observation will show a rise of the petroleum column, thus indicating that the volume of the tin has increased by the formation of the specifically lighter gray tin, so that the critical point must be above 15 deg C. By successive operations a gradual approach to the critical point is obtained by working at temperatures alternately above and below said point, and when the limits have been restricted sufficiently, interpolation is resorted to. This method also showed that the critical temperature must be in the neighborhood of 20 deg. C., and careful determination proved it to be almost exactly 18 deg. Centigrade (about 65 deg. Fahrenheit).

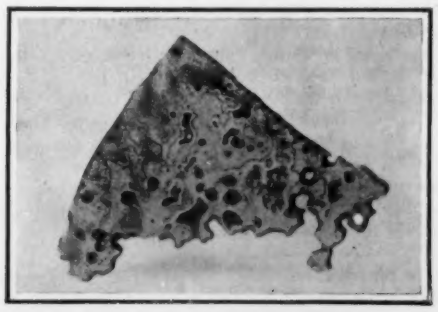
Since all tin utensils employed by us are made of the white modification, it follows that they are gen-

Antique coffee pot perforated by the tin disease.

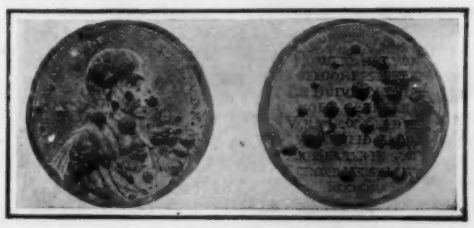
Results of inoculation with wrought metal disease.



A sick block of Banca tin three weeks after infection.



Infected leaf tin.



Metal infected by tin pest.

Infected sheet tin from Rotenburg City Hall.

erally in an unstable condition and liable to be transformed partly into the gray variety, except on days when the temperature exceeds 65 deg. Fahrenheit.

The second method described above was also utilized to ascertain at what temperature the transformation of white tin into gray tin proceeds with the greatest rapidity and this was found to be the case at about 48 deg. Centigrade below zero (about 54 deg. F. below zero).

An interesting discovery was that the transformation is hastened considerably by the presence of a few particles or "germs" of gray tin. It follows that if an "infected" piece or object of white tin is left to itself at temperatures below 65 deg. Fahrenheit, the transformation will proceed constantly and with increasing rapidity, for each particle of gray tin, as soon as it is formed, becomes a new germ accelerating the transformation. Prof. Cohen has given this phenomenon the name of tin pest in view of the germ-like or infectious action of the gray tin particles, and also in view of the fact that the tin so attacked is practically ruined, since the restoration of tin by melting is attended with great losses owing to the strong oxidation which takes place during the heating, on account of the finely divided condition of the gray tin.

The formation of blisters during the conversion of the tin into the gray variety is a natural consequence of the increase of volume, since gray tin is about 25 per cent lighter than white tin.

Tin articles which have been exposed to low temperatures for a long time, say several centuries, would naturally be expected to exhibit a maximum of deterioration. This is indeed the case, as has been proved by the condition of antique tin vases, medals, and other objects dug up in our times. In museums, too, the deterioration of tin articles has been observed frequently, but the cause was not understood and no remedy was known. In the light of Prof. Cohen's discoveries, the remedy is simple: we have only to see to it that the articles are never exposed to a temperature below 18 deg. Centigrade (65 deg. Fahrenheit). Investigation has shown that in many cases where excessive and apparently unaccountable deterioration of tin articles had been reported, the articles had been exposed to low temperatures during the winter.

WROUGHT METAL DISEASE.

Strange phenomena were observed by R. von Hasslinger at the tinned solder seams of an air-compressor made of tinned sheet iron. The solder had melted away in spots, as it were, and had assumed a crystalline structure; the tin covering of the sheet iron had become granular and dull on its entire surface. It was unlikely that the result was due to tin pest, since the compressor had seldom, if ever, been exposed to temperatures below 18 deg. Centigrade. R. von Hasslinger ascertained that pieces of this diseased tin would infect sound tin, and that this was apparently independent of the temperature, thus indicating again that the form of tin pest previously recognized was not the cause of this newly observed transformation. The tin became crystallized in minute wart-like bodies and the dull portion would spread gradually, but the rate of growth decreased with the increasing distance from the center of infection. R. von Hasslinger thought that the phenomenon was due to crystallization, and continued his experiments, showing that the modified tin had a lower melting point than the original metal, about 205 deg. Centigrade instead of 232 deg. He also found that tin foil infected on one side would become modified on both sides. Other experiments made by him, however, seemed to indicate that the crystallization theory was erroneous, and he published the result of his observations with an acknowledgment that he was unable to account for them. An untimely death having prevented von Hasslinger from concluding his investigations, his teacher, Prof. Guido Goldschmiedt, of Prague, drew Prof. Cohen's attention to the unexplained phenomena and suggested that he continue the research.

Prof. Cohen repeated von Hasslinger's experiments and verified them in many ways. He ascertained that the small lead contents of the tin would in no way be held responsible for the result. He first believed that the phenomena might be explained by the formation of the rhombic modification of tin, which is unstable at temperatures below 161 deg. C., having a tendency to resume the normal tetragonal form. If this hypothesis had been correct, the phenomena should have been absent at temperatures of 161 deg. C. and above. Experiments, however, showed that the transformation into the new dull, powdery form of tin took place at 184 deg. C. even more rapidly than at lower temperatures. This hypothesis therefore had to be abandoned.

Prof. Cohen then turned to another explanation, based on two well-known facts: First, that a metal which has been subjected to a tensile or to a compression strain (such metal being designated as "wrought metal" by Prof. Cohen) has an electrolytic solution pressure higher than the same metal if it has not been subjected to mechanical forces; second, that several metals, tin among others, have the property of recrystallization, that is, of exhibiting a growth of their individual crystal grains, more particularly at high temperatures.

It is well known that two specimens of "wrought metal" are seldom absolutely identical in an electrolytic sense, and "wrought metal" is in an unstable condition, having a tendency to return to the condition of "unwrought metal." This tendency, slight at ordinary temperatures, ought theoretically to be strengthened by an increase of temperature, within certain limits, and it is also to be expected that inoculation with the form most stable under the particular conditions of the case, would hasten the transformation. These theoretical deductions have been fully confirmed by experiments.

Prof. Cohen cleaned some plates of tinned sheet iron with hydrochloric acid and potassium chlorate. This produces, in a short time, the well-known metallic moiré effect. The surface is then washed carefully and rubbed with a fine handkerchief. The plate so prepared is pressed in a vise against a highly polished plate of tinned sheet iron, and upon heating to 184 deg. C. the polished plate becomes infected and acquires the property of infecting others. If however both plates are highly polished, no modification will occur. Another experiment consisted in applying to a moiré plate such as mentioned above, some powdered infected tin foil and on top of this, a polished plate of tinned sheet-iron. Heating to 100 deg. C. caused the polished plate to be affected immediately, while the moiré plate remained unaltered even after 24 hours.

It follows that "wrought tin" (rolled tin, tinned sheet-iron, tin foil) must be considered an unstable product, in process of recrystallization. The form which is stable at ordinary temperatures is the gray tin, but the transformation is extremely slow at such temperatures. Within certain limits, an increase of temperature increases the rapidity of transformation. Contact (inoculation) with the more stable form also accelerates the transformation appreciably. Tinned sheet-iron and tin foil are always in an unstable condition; above 18 deg. C. there is a tendency of transformation into the "unwrought tin" variety, and below 18 deg. C. there is a tendency to assume the form of "unwrought tin" and also that of the gray tin.

The phenomena observed by von Hasslinger are therefore due to structural changes wrought by the mechanical processes to which the metal is subjected during manufacture. Hence the name "wrought metal disease" selected by Prof. Cohen.

In view of the considerations developed above it would be natural to find similar phenomena in the behavior of metals other than tin. As a matter of fact, several such cases were brought to the attention of Prof. Cohen and his collaborator, Prof. Katsuji Inouye. Lamp fonts made of rolled brass were found to become badly corroded in a short time, so as to exhibit cracks and holes. This could be readily explained as due to a recrystallization, a transformation into the form of the metal more stable under the particular conditions. Similar effects of corrosion were observed on brass door handles, and Prof. Cohen also thinks that "wrought metal disease" accounts for the peculiar deterioration of the rolled lead roof of a sulfuric acid factory. The temperature of from 40 deg. C. to 60 deg. C., to which the roof had been exposed, was very favorable to the recrystallization process.

The Current Supplement.

The opening article of the current SUPPLEMENT, No. 1799, describes a saw-dust compressing machine.—Recent developments of American locomotives are discussed.—Mr. Leon A. Hackett's excellent article on the Processes in Cotton Spinning is concluded.—Prof. J. A. Ewing reviews the work of Lord Kelvin in telegraphy and navigation.—In an excellent article entitled "Oil Field Phenomena," Mr. A. Beeby Thompson gives a brief review of the mode of occurrence of petroleum and the means adopted for its search and recovery.—Mr. R. T. Hewlett writes on soured milk from the Metchnikoff standpoint.—Plant anesthetics is explained by S. Leonard Bastin.

It is reported in the Electrician that the Chicago Elevated Railway Commission is considering five plans to solve the problem of "through routes" for elevated trains in that city. Thirty-eight plans were submitted to the Commission, and five of these were selected for more careful study. Mr. B. J. Arnold, who is chairman of the Commission, feels that progress has been made in narrowing down the work. It is pointed out that each of the four elevated railway companies is operating under a separate ordinance granted by the city, and that the inter-relation of the elevated lines is caused by the joint use of the "down-town" Union loop. The companies are doubtful whether they can afford to haul passengers for a greater distance than about six miles for five cents, but there is apparently a desire on the part of everybody concerned to reach a solution of the question.

Correspondence.

A CALL TO AMATEUR WIRELESS OPERATORS.

To the Editor of the SCIENTIFIC AMERICAN:

The amateurs and experimenters in wireless telegraphy in New York city and Philadelphia have started a movement to organize all the amateurs in America with a view of expressing to Congress the opinion of the organized amateurs as regards restrictive legislation. The amateurs desire that a full opportunity may be given them to express their views to Congress before any of the pending bills be enacted into law.

I have been retained as counsel for this movement. If your valuable paper will publish this letter, I trust that every wireless enthusiast throughout the United States will send his name to me at my office, Hibbs Building, Washington, D. C.

GEO. HIRAM MANN.

"MECHANIPULATE."

To the Editor of the SCIENTIFIC AMERICAN:

Relative to your suggestion, regarding the new word proposed by Mr. Wood, namely, "mechanipulate," it seems to me rather complicated, and I would suggest that the more homely term, machining or machined, would be far more appropriate in the application which he suggests. E. W. MOORING.

Waterbury, Conn.

[The term mechanipulate does not refer to the "machining" but to the mechanical handling, i. e., moving, placing, centering, etc., of a piece of work. —ED.]

GIVING THE APPEARANCE OF RELIEF TO PICTURES.

To the Editor of the SCIENTIFIC AMERICAN:

A simple method of giving the appearance of relief to pictures can be seen by the experiment that if a sheet of glass with minute cylindrical fluting on a side held against a photograph, with the series of flutes vertical, be viewed through, the dispersing light gives the picture a stereographic effect of solidity.

The utility of a minutely fluted dispersing picture cover glass screen therefore can be shown, which is caused by the semicircle dispersion by the cylindrical flutes of the light that is reflected by the photograph. The determining factors are the minuteness of the fluting and the position and the thinness of the viewing screen.

The dispersion of the light by the refraction through these adjoining flutes of this stereoscopic screen presents to each eye a different appropriate view of the picture, which produces the impression of solidity and depth. A. F. WOOD CHENOWETH.

London, England.

Scientific American Prizes for Inventors.

The SCIENTIFIC AMERICAN offers $100 in three prizes, to be awarded to the inventor who gives the best account of how he conceived his invention, how he developed it in actual practice, and how he succeeded in selling it. This sum of $100 to be distributed as follows: $50 to the best account, $35 to the second best account, $15 to the third best account.

There is no limitation as to subject matter of the invention. In other words, the invention may be a household utensil, a game, a piece of electrical apparatus, an improvement in railway construction, a metallurgical process, etc. The following conditions, however, must be observed:

1. The invention must be patented.
2. The inventor must have actually sold his patent, and the invention must have been commercially introduced.
3. The account of the inventor's success must not be longer than 800 words.
4. The composition, letter, or article must be typewritten on one side of the paper only.
5. The inventor must sign his offering with a pseudonym, and inclose it in a sealed envelope, upon which the pseudonym is written. A second sealed envelope must be provided, bearing on the outside the pseudonym under which the offering is submitted, and containing the real name and address of the contestant.
6. Contestants must address their offerings to Inventors' Prize Editor, SCIENTIFIC AMERICAN, 361 Broadway, New York city.
7. The contest remains open until August 15th, 1910. Judges will select the essays which, in their opinion, have won the three prizes and give them to the Editor of the SCIENTIFIC AMERICAN, who will thereupon open the sealed envelopes containing the true names of the contestants, and notify the winners of the prizes.
8. The Editor of the SCIENTIFIC AMERICAN has the right to publish the prize winning articles or letters as well as those which may not receive prizes.
9. Unsuccessful letters cannot be returned. It is therefore urged that the contestants preserve copies of their contributions.

Independence Day Casualties.

BY JOHN B. HUBER, A.M., M.D.

In these columns of the issue of July 3rd, 1909, under the title "Tetanus and the Glorious Fourth," I submitted data regarding the dreadful injuries and deaths suffered year after year by our children and youth because of the methods with which for a century and more our people have been celebrating Independence Day. I pointed out that the greatest danger lay in tetanus or lockjaw; and that most of the cases of "Fourth of July tetanus" have come about through the use of blank cartridges in toy pistols and of giant firecrackers.

I dwelt upon the tetanus bacillus, the germ responsible for this disease, which is introduced, in impregnated dirt, into wounds—sometimes very slight indeed—of the face, hands, and feet. I noted that the incubation period of tetanus (while the toxins generated by the bacillus are disseminating in the blood; and before the dreadful symptoms develop) is from five days to a fortnight; that prophylactic injections of anti-tetanus serum, if given immediately after the injury, will almost certainly ward off this disease, which before its introduction was fatal in more than four-fifths of the cases; that practically all health departments are now open on Independence Day, prepared to provide this antitoxin, when asked for it by telephone; that in the event of any wound, immediate and heroic surgery is imperative; and that if any such wound be examined under the microscope for the secretion, the latter's absence after several examinations should greatly allay fear of the disease developing.

During several years past humane citizens, anxious to prevent these deaths and sufferings among our young people, have striven to interest public opinion in the substitution of celebrations of the great national holiday every whit as patriotic, while at the same time much safer and saner, and at least as conducive to pleasure and patriotism as those that have hitherto obtained; and year by year the success of these endeavors has been progressive. I would here sketch what has been done in these premises during the last twelvemonth.

Last year Independence Day fell on Sunday—the chief reason, no doubt, why the number of tetanus cases, which had theretofore been steadily decreasing, doubled in 1909 those of the preceding year. The coming holiday falls on Monday, so that the festivities are likely again to be spread over three days. There seems moreover to have been relaxed authority regarding the use of fireworks, especially in Illinois, Massachusetts, New Jersey, New York, and Pennsylvania; this relaxation regarding especially the use of blank cartridges resulted in an increase of tetanus cases. Nevertheless, last year there was gratifying evidence of an increased public sentiment in favor of more rational celebrations. Two cities, Washington and Cleveland, joined those which had already passed prohibitory ordinances; and Chicago enforced a restrictive ordinance, with the result that no casualties were reported from Washington, only four slight injuries for Cleveland, and less than half the usual number of accidents—with no deaths—for Chicago, although this latter city had 12 deaths in 1908 and 16 in 1907. Prohibitive ordinances have been more effective than restrictive ordinances; the latter in turn are much better than the do-nothing policy.

As I have intimated, year by year efforts have been progressively making to substitute sensible amusements and enthusiasms for the explosive celebrations that have resulted in 794 tetanus deaths among our children in seven years. Springfield, Mass., while abating not a jot—indeed, rather enhancing—a spirit of genuine patriotism, has provided parades, floats representing historic incidents, picnics; and, finest of all, an annual chorus drilled by skilled leaders in the mass singing of national airs and popular songs. How worthy of emulation by other communities! How gratifying to all but the "business interests" involved!

The Journal of the American Medical Association has for seven years past demonstrated by statistics the appalling number and character of the casualties resulting from our wonted celebrations. As I have noted, blank cartridges alone furnished 794 tetanus deaths in those years; and the disease of which these children and youths—all under eighteen—are the victims, is the most agonizing known to medical science. The deliberate tortures of the Inquisition hardly paralleled such suffering. If, in the face of these undoubted facts, it will be decided to adhere to the old order of things, far more merciful would it be to pick out a hundred or more youths the coming Fourth and deliberately shoot them in any market place. Prevention of these annual outrages, in the light of our indubitable knowledge, now rests squarely upon our city governments; neglect in this regard were now, to say the least, criminal in our constituted officers. The public should keep them firmly to this duty.

The celebration of this year, despite its probable three days' length, will likely, unless all signs fail, be safer and saner than ever before in our history. All classes of publications are taking up the propaganda begun by the American Medical Association; newspapers and magazines are utilizing the statistics which its Journal has submitted. One magazine imagines the results of a vote by Congress to sacrifice each year one unknown boy as a national Fourth-of-July offering—the newspaper extras announcing the grotesque and extraordinary action, editorial denunciations of our law-makers, the public agitation and supreme indignation, petitions to Congress and the President, the tumult that would inevitably attend the execution of such an act of madness. Yet we have supinely been allowing, year after year, with the absolute certainty of the result before us, the slaughter of hundreds and the mutilation of thousands of our children, with the natural consequence in suffering, torture of mind, and desolation in many households.

Our people are indeed well on the way to grasping the logic of these presentments. Everywhere individuals, civic societies, and kindred organizations are at work; measures are on for the formation of a national committee to promote a "safe and sane Fourth"; municipal authorities are acting understandingly; to legislation hitherto enacted, more has been or will be added this year. The action of the Medical Society of the State of Pennsylvania is especially noteworthy by reason of its comprehensive character. Its Committee on Independence Day Fatalities recommends: Legal control of the importation, manufacture, and sale of explosives used only for purposes of celebration; municipal control of the use of firearms and of fireworks during the Fourth-of-July season; municipal participation in substitution methods; the organization of societies for both control and substitution purposes; the most complete possible systematic use of tetanus antitoxin, and other medical measures in both the prevention of tetanus and sepsis (blood poisoning); the setting apart of a day in all public schools, academies, and colleges during the last day of the session before the summer holiday, to make all possible provision against the evil; the allusion to the matter in all churches on the last Sunday preceding Independence Day; the continuance and increase of the agitation in the newspapers.

In the metropolis much humane activity has been manifested. Many most excellent suggestions have been made. The mayor especially suggests a grand parade made up of our national guard, contingents from the United States army and navy, and from the police and fire departments (whose heroic services would, under the new regime, not be so much needed on this occasion); civic, patriotic, historic, charitable, and industrial organizations could join; school boys and girls of suitable age could take part. At night the authorities could superintend the city's own fireworks display in the rivers and on the great bridges.

THE AVIATION MEET AT INDIANAPOLIS.*

America's first aviation meet under the auspices of the Wrights was held last week at Indianapolis above the new automobile race track. A one and one-half mile course for the aeroplanes to cover was marked off with flags. Orville Wright opened the meet on June 13th by circling twice around this course and executing some graceful maneuvers such as sharp turns and sudden dives. Walter Brookins, one of the five aviators Orville Wright trained recently at Montgomery, Ala., is reported to have made four laps of the course (6 miles) in 6¾ minutes, or at the rate of 53 1-3 miles an hour.

Subsequently Mr. Brookins made a new height record by flying in circles to a height of 4,384½ feet. According to the observations of the men who were taking the height, he attained an altitude of 1,900 feet in 7 minutes. It took him a half hour to reach the greatest height. He descended in circles the same as when he ascended, and when within a hundred feet of the ground, he shut off the motor and glided to earth. The following day Brookins continued his exhibition flights and gave another demonstration of his skill as an aviator by flying for nearly an hour in a stiff wind. After doing many fancy maneuvers he made a glide and landed almost at the starting point. One of the other Wright machines had trouble with its motor and was unable to make more than a half circuit of the course. There was very little flying this day on account of the wind.

The third day of the meet Brookins again attempted to make an altitude record, but only succeeded in reaching a height of a little over 1,700 feet. After the usual performance of the five Wright biplanes, Orville Wright made a flight in which he performed numerous and daring evolutions over the trees in the surrounding fields. His machine flew very steadily and made sharp turns, but did not show the speed that Hamilton exhibited in his Curtiss biplane at Mineola.

On the fourth day of the meet aviator Brookins well nigh outdid Orville Wright in the fancy maneuvers he executed and in the sharp turns he made. He created a new world's record for turning by making two turns in 6 3-5 and 6 1-5 seconds respectively. The circle he described was less than 150 feet in diameter. The best previous record of this character is said to have been made by one of the Wrights recently at Dayton. Brookins again attempted to break his altitude record, but only succeeded in reaching 3,800 feet after a 45-minute ascent. He required only 10 minutes to descend from this height. Two and three aeroplanes were frequently flying together during the afternoon, and at one time the motor in aviator Hoxsey's Wright machine suddenly stopped when he was at a height of 200 feet. He glided down in a straight line and landed in a field quite a distance away.

On the fifth day, Brookins again attempted, and this time successfully, to break his altitude record. After soaring in wide circles for 40 minutes, he reached a height of 4,503 feet. The machine was but a speck in the sky and on account of the haze and the lateness of the hour, it was sometimes momentarily lost to view. After apparently hovering for several minutes, he began a slow descent in wide circles. Brookins circled five miles to the east of the motor speedway and gradually closed in upon it. He had difficulty in seeing the track because of the gathering darkness. The motor stopped when he was only half way down and he was obliged to make a long glide. He finally landed in a farmer's yard a couple of miles from his starting point. The flight had lasted an hour and a half, and it was by all odds the best attempt at high flying that has yet been made.

The Indianapolis aviation meet did not draw the crowds anticipated. This was doubtless due to the fact that only one make of aeroplane was used. In order to have a good sporting event, various types of machines must compete. At the meeting in Montreal, from the 25th inst. to July 4th, there will be two Blériot monoplanes, in addition to the five Wright biplanes and the biplane of J. A. D. McCurdy. There may also be some other machines entered at the last moment. Count Jacques de Lesseps, who recently flew across the English Channel, will pilot one of the Blériot monoplanes. This machine has a 50-horse-power motor and will be able to outdistance the Wright biplanes, which have only 30-horse-power engines. In all probability, there will be some interesting races at this international meet.

* For illustration see page 521.

Wanted: Information About Dishonest Patent Schemes.

The SCIENTIFIC AMERICAN has always made a practice of exposing the snares and devices of the patent promoter, as well as the fraudulent patent attorney. Although the subject is by no means new to the readers of the SCIENTIFIC AMERICAN, it is one of which all inventors should be thoroughly informed. The Editor of the SCIENTIFIC AMERICAN would like to receive from readers of this journal, letters in which they narrate their personal experiences with dishonest promoters and attorneys. Such letters will be published in due course, and should not only be of interest in themselves, but should serve as a warning, thereby protecting others against such snares.

The staff of the Bureau of American Ethnology of the Smithsonian Institution has recently been increased by the addition of two ethnologists who have come to their work with the prestige of high university distinction. The first of these, Dr. Truman Michelson, studied comparative philology at Harvard, and then continued his studies abroad at the universities in Leipsic and Bonn. He then taught comparative philology at the University of Missouri in Columbia, and more recently has been a student under Boas at Columbia University in New York city. He has published various papers in his specialty, and has in press a revision of Jones's "Grammar of the Fox Language." Dr. Michelson will undertake to determine the linguistic interrelationship of the greater groups of the Algonquian languages. For this purpose he will visit during the summer the Blackfeet reservation and the Northern Cheyenne reservation in Montana, then the Windriver in Wyoming, and Menomoni reservation in Wisconsin, and the Micmac reservations in Quebec and New Brunswick. The other of these new appointees is Mr. Paul Radin, who has prosecuted advanced studies in anthropology at the universities in Berlin and Munich, and during the last four years has been a student under Boas and Farrand at Columbia University in New York city, from which institution he is soon to receive his doctorate. Mr. Radin has taught at the College of the City of New York, but has decided to relinquish teaching in order to follow ethnological studies as a life-work, and to him the Bureau has assigned special investigations among the Winnebago Indians of Nebraska. Mr. Radin is the author of numerous papers which have appeared in the Zeitschrift für Ethnologie, the Journal of American Folk-lore, and the Proceedings of the Royal Anthropological Institute of Great Britain and Ireland.

THE GERMAN DREADNOUGHT "NASSAU"

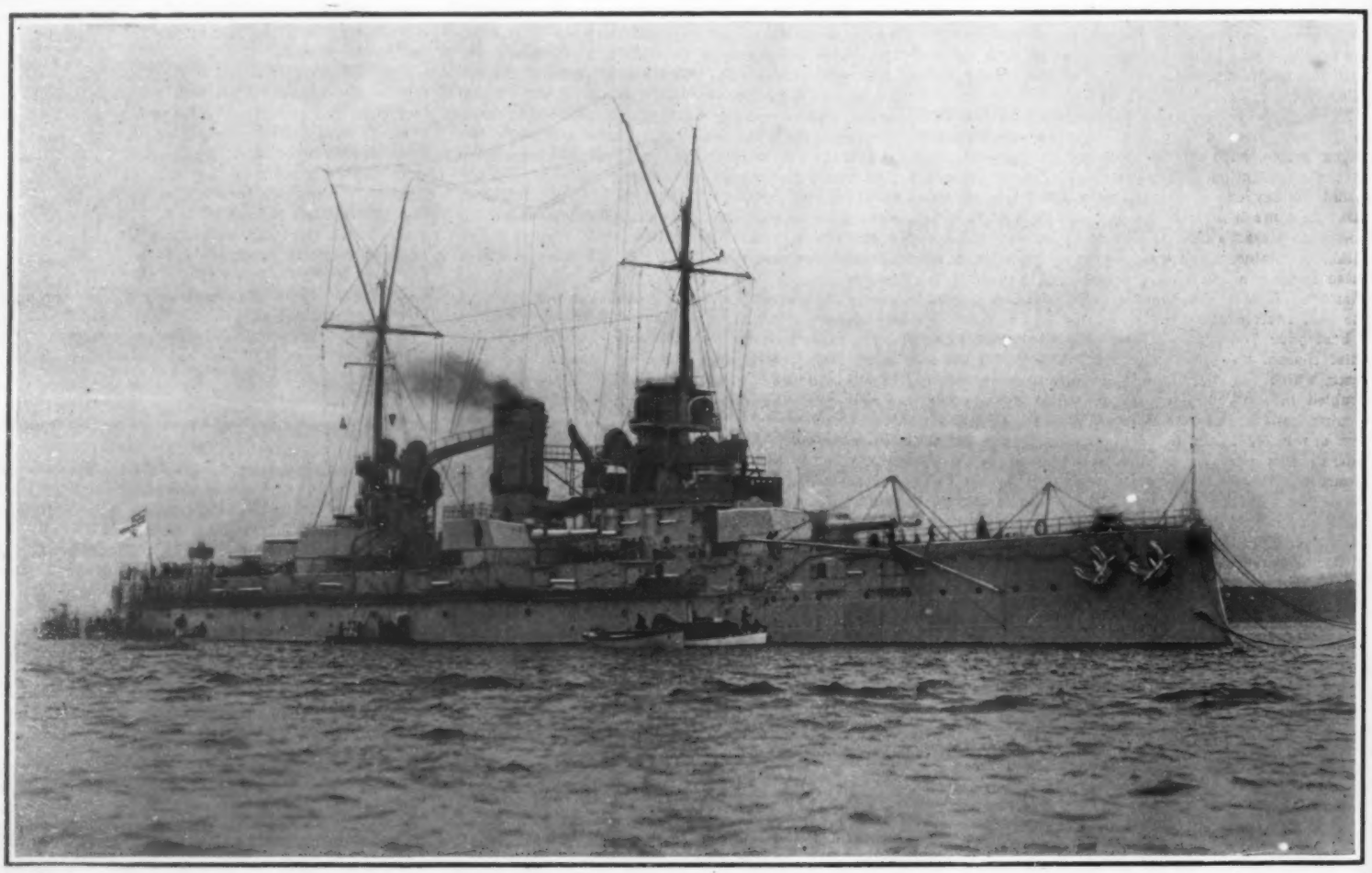
THE FIRST OF THE GERMAN FLEET OF DREADNOUGHTS TO BE COMPLETED

In view of the great secrecy which has attended the construction of the "Nassau," the type ship of the fleet of German dreadnoughts, some surprise was expressed upon the first public view of the ship, that she possessed, as a dreadnought, no features of marked novelty. To the people of the United States, there is something familiar about the arrangement of her main battery, with its armament of heavy guns carried in six turrets, one forward and one aft of the center line, and four arranged amidships quadrilaterally. Their thoughts will be carried back some twenty years to the time when the plans of our first battleships "Oregon," "Massachusetts," and "Indiana" were made public. The distinctive feature in these vessels was the heavy battery which they carried and the novel plan upon which it was disposed, the pairs of 13-inch guns being carried in turrets forward and aft, and the pairs of 8-inch guns being mounted in four turrets, two on either beam, arranged at the four corners of the superstructure. This, it will be observed, is practically the plan followed in the ships of our own navy, the guns are all mounted upon the longitudinal axis of the ship, and consequently the whole power of the 12-inch battery can be brought to bear on the broadside throughout a wide arc of training.

In justification of their adoption of the quadrilateral system of mounting, the Germans announce their conviction that in the engagements of the future there will be more fighting in the end-on or quartering position than the advocates of the all-centerline system of mounting believe; and they emphasize the fact that the "Nassau" can not only concentrate six heavy guns in the end-on position, but that she could deliver this heavy fire, should the exigencies of an engagement demand it, both forward and astern at the same time. Furthermore, there is a certain advantage in the fact that two guns and four turrets are held in reserve on the lee side and are greatly protected by the turrets which are in engagement on what might be called the weather fighting side of the ship.

However, in estimating the merits of warship design, we must be careful to bear in mind the question of displacement, which in the "Nassau" stands at the very moderate figure of 18,500 tons; and, if we remember that our latest dreadnoughts have run up to 26,000 tons, it must surely be admitted that the Germans, in view of the limited displacement of the "Nassau," have turned out a decidedly creditable ship.

The following dimensions, which have been obtained through the courtesy of the German Navy Department, may be taken as correct: Length, 452 feet; beam, 89 feet; draft, 26½ feet; displacement, 18,500 tons; normal coal supply, 950 tons. The "Nassau" is driven by triple engines, and on her trials considerably exceeded her contract speed of 19 knots and may be set down as a 20-knot vessel. The armament consists of twelve 11-inch, twelve 6-inch, and sixteen 3.4-inch guns. She is protected by eleven inches of Krupp armor on the belt and the barbettes and turrets, and twelve inches on the conning-tower.



Length, 453 feet. **Beam,** 89 feet. **Draft,** 26½ feet. **Displacement,** 18,530 tons. **Normal coal supply,** 960 tons. **Armor:** Belt, 11 inches; turret and barbettes, 11 inches. **Armament:** Twelve 11-inch, 50-caliber guns; twelve 6-inch guns; sixteen 8.4-inch guns.

"NASSAU"—FIRST OF THE GERMAN DREADNOUGHTS.

"Nassau." Incidentally, it may be mentioned that the Japanese have adopted the same arrangement in the first dreadnoughts built for their navy.

Obviously, the principal disadvantage of the system is that the ship, although she mounts twelve heavy guns, can bring only eight of them to bear upon either broadside, at least four guns being masked by the superstructure or by the other turrets while she is fighting a broadside engagement with the enemy. In Should the weather guns be disabled, it would be possible for the fleet to make a complete turn of 180 degrees, and bring four big guns, with their gun crews entirely fresh, into the fight.

To these arguments it will be answered that, by moving one of the four amidship turrets forward and placing it at a sufficient height to fire above the foremost turret, and removing another of the turrets aft and giving it a similar relation to the aftermost turret, not only would the broadside fire of the "Nassau" be increased from 8 to 12 heavy guns, but the end-on fire would be strengthened by the addition of two more guns, raising it from a concentration of six to one of eight guns. This is the method adopted in the new Argentine cruisers, the most powerful dreadnoughts now under construction, which will be able to fire eight guns ahead or eight astern, or twelve on either broadside.

An English Judicial Opinion of Complex Patents.

The complexity of patent specification phraseology, and particularly the bewildering character of the claims of an American patent, were recently made the subject of a decision of the House of Lords. The case, which five members of the House were called upon to decide, was that of Linotype and Machinery Limited vs. Hopkins. We presume that the specification, which called forth the condemnation of the Lords, was simply the American specification filed in England without any change. The following is an extract from the decision, the unanimous judgment of the five members of the House of Lords:

"The appellant (i. e., the patentees) has filed a specification which resembles a treatise in its length; it contains no less than sixty claims; there is infinite redundancy and repetition and constant reference to illustrations which are not very easy to follow. Altogether it is a document which needs the most prolonged and penetrating study in order that anyone, who wishes to work out problems of invention in this circus of industry, may know where they stand and how they may be free from the danger of infringing former patents.

"The point whether this patent is good or not does not arise in this case, but I think it is my duty to state explicitly that those who file and secure specifications must take the risk of having the whole thing declared void for ambiguity. I have had occasion to observe that there is a tendency to frame specifications and claims so as to puzzle a student, and to frighten men of business into taking out a license for fear that their interpretation may be held erroneous and they be found guilty of infringement. That is an abuse of the law and will be checked if occasion should require, by the simple process of declaring the patent invalid."

Uranium is found commercially in only two minerals in the United States, pitchblende and carnotite. Pitchblende, which is widely known because of its use as an ore of radium, occurs in quantity in the United States only in Gilpin County, Colorado, where there are four mines that produce it. Carnotite occurs as a yellow powder in sandstones in Utah and Colorado.

Hamilton's Round-Trip Aeroplane Flight from New York to Philadelphia

A REMARKABLE CROSS-COUNTRY FLIGHT

Only a few days after Glenn H. Curtiss's flight from Albany to New York, aviator Charles K. Hamilton made a more daring and thrilling flight from New York to Philadelphia. This second flight was planned by the New York Times and the Philadelphia Public Ledger, and aviator Hamilton, carrying a letter from Mayor Gaynor of New York to Governor Stuart of Pennsylvania, executed the flight on schedule time. During a considerable part of the trip he raced a special train which at times found difficulty in keeping up with him.

The start was made from Governor's Island at 7:36 A. M. on Monday, June 13th. The actual start took place only after Hamilton had broken a propeller in attempting to start the first time, due to the blade striking a stick that lay upon the ground. As soon as he had substituted a new propeller—the very one used

(*Continued on page 527.*)

Walter Brookins flying at the Indianapolis meet.
Brookins made a new height record of 4,503 feet.
For description see page 519.

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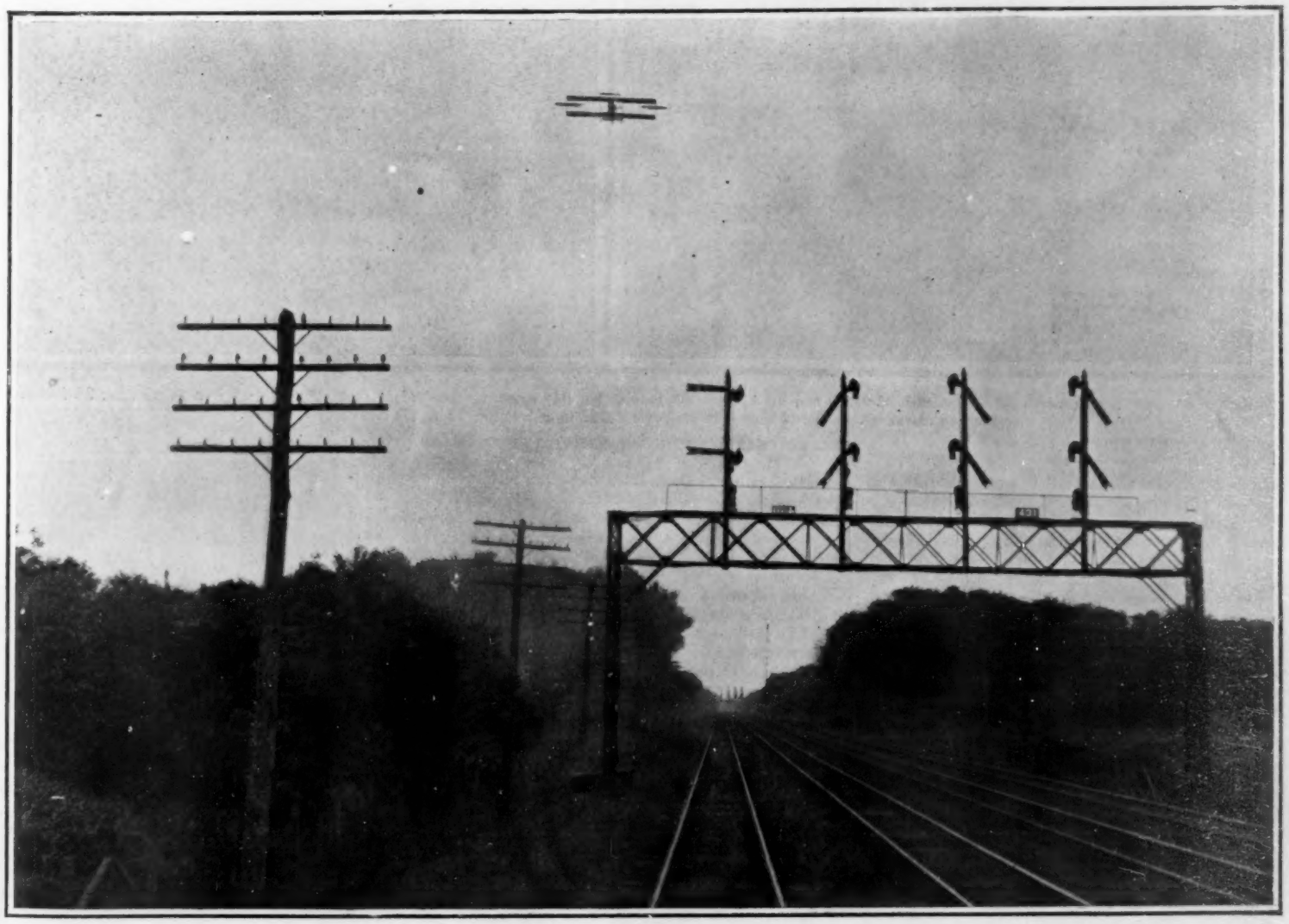
Hamilton handing Mayor Gaynor's message to Gov. Stuart upon his arrival in Philadelphia.



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Hamilton flying above the Pennsylvania Railroad tracks in pursuit of the special train.

HAMILTON'S ROUND-TRIP AEROPLANE FLIGHT FROM NEW YORK TO PHILADELPHIA.

New Filtered Water Supply for the City of Pittsburg

HOW THE ALLEGHENY RIVER WATER IS PURIFIED AND DELIVERED INTO THE CITY MAINS

There has recently been completed for the city of Greater Pittsburg an ambitious scheme of pure water supply which represents the very latest developments in work of this character. The site for the filtration plant is on the north bank of the Allegheny River, about seven miles above the point where it joins the Monongahela to form the Ohio. The new plant is located a short distance above, and on the opposite side of the river to the Brilliant Pumping Station, which formerly took water from the river direct. The plant extends along the river front for 3,700 feet and covers some 225 acres.

At the upstream corner of the site, low-lift pumps, located in what is known as the Ross Point Pumping Station, raise the raw water to a central receiving or sedimentation basin of 20,000,000 gallons capacity. On each side of this receiving basin is a larger sedimentation basin and the three have a combined capacity of 130,000,000 gallons. From the central receiving basin, water flows to the rest of the plant by gravity, flowing first to the sedimentation basin, and thence to the slow-sand filters, from which it is conveyed to a covered filtered-water reservoir on the bank of the river. From the reservoir the water passes through two steel conduits, laid under the river, to the high-service, Brilliant Pumping Station, which lifts the water to the storage reservoirs that supply the distribution system of the city.

The intake has been built back of a revetment which has been constructed along the river bank in front of the Ross station, and it consists of a concrete chamber to which the river water is admitted by sixteen four-foot conduits arranged in two horizontal rows of eight each. From the intake the water passes through a 124-inch conduit for a distance of 230 feet to the pumping station.

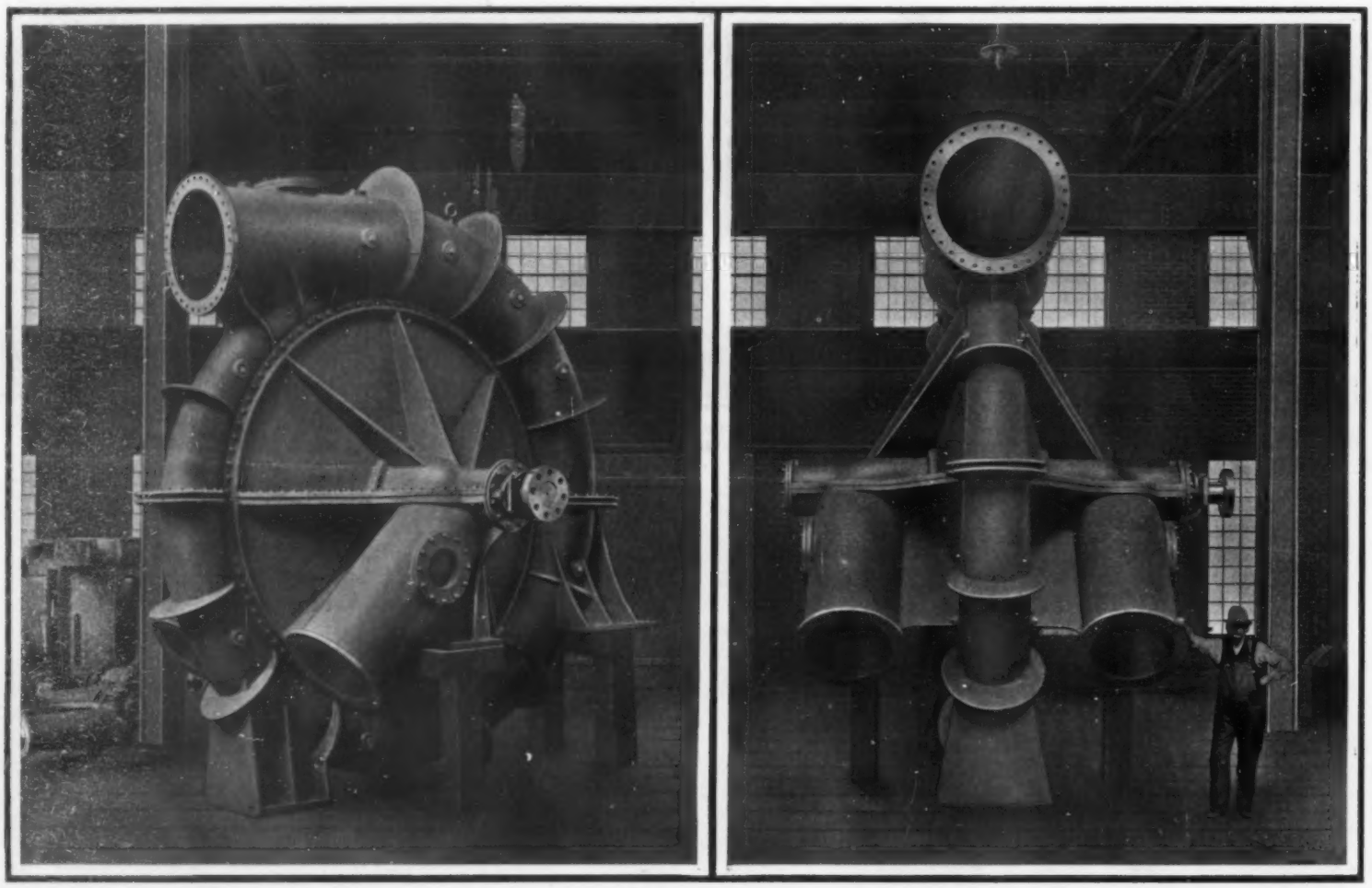
The Ross Point Station measures 128 by 200 feet in plan. The steam-generating equipment consists of eight 350-horse-power, horizontal, Sterling water-tube boilers arranged in batteries of two each. Extending along the front of the building is a pump pit 28 feet wide and 16 feet deep. In this are placed four Allis-Chalmers horizontal shaft, single-stage, double-suction, centrifugal pumps, each direct connected to an Allis-Chalmers vertical, cross-compound condensing Corliss engine. Each pump has a rated capacity of 35,000,000 gallons per 24 hours, when pumping against a total head of 46 feet of which not more than 14 feet is suction lift. The impellers of the pumps are 11 feet 3 inches in diameter. The suction nozzles are each 28 inches, and the discharge nozzle is 36 inches in diameter. The external construction of these pumps is clearly shown in the accompanying illustration.

The 100-inch conduit, before mentioned as conveying the raw water, extends under the pump pit and forms a suction pit for the pumps, which discharge through branch connections to a 96-inch rising main that extends 1,853 feet to the central gate-house. The rising main is built of half-inch riveted steel plates surrounded by concrete. The flow of water through the rising main is measured by a 96-inch Venturi meter with a 50-inch throat—the largest meter of this type ever built. At the discharge end of this main is a central gate chamber 50 feet by 53½ feet, which controls the flow of water to and from the sedimentation basin. Above this chamber is built the administration building, from which the entire operation of the plant is controlled and directed.

There are three sedimentation basins, the two larger ones covering about twelve acres, and the smallest about three acres. Water is carried to a depth of about fifteen feet and the total capacity is 130,000,000 gallons, or about one day's supply. The 56 filters have each a surface of one acre and a capacity of 3,000,000 gallons per 24 hours. Each filter bed measures 163 by 263 feet, and it is completely roofed over. The floor is of concrete, and the groined-arch roof is supported by 170 columns, each 22 inches square spaced 15 feet center to center. The under drainage or collecting system consists of a central main collector extending down the central bay, with lateral collectors of vitrified tiles in each side bay, laid in open joints. The collectors are covered with one foot of gravel, varying from one-fourth inch to three inches in size, above which is a layer of sand four feet thick. An interesting feature is the new system for scraping the beds and cleaning and replacing the sand. The work is done by machinery instead of by hand, and the system is the most complete in this country.

The collectors beneath the filter beds lead to conduits in the galleries, and these connect with the main conduit, which leads to the filtered-water reservoir, which has a capacity of 50,000,000 gallons. The latter is built of plain concrete with arched floor and roof, the latter being carried on 775 round columns 27 inches in diameter, 21½ feet high, spaced 18 feet center to center. These arches are believed to be the largest of this type that have ever been built.

From the filtered-water reservoir the water is carried by two 72-inch steel pipes beneath the river to the Brilliant Pumping Station. Originally, this pumping station had a daily capacity of about 98,000,000 gallons; the plant consisting of two 10,000,000-gallon Holly engines and two 15,000,000, and four 12,000,000-gallon Allis-Chalmers vertical cross-compound pumping engines. At the time of the building of the filtration plant, two additional 15,000,000-gallon vertical Allis-Chalmers pumping engines were added. The grounds of the filtration plant, which occupy about 225 acres, have been developed into a very beautiful park. The filters and filtration reservoirs, which, as we have noted above, are covered, have been overlaid with several feet of soil which has been sodded. Macadam road drives planted with trees have been laid out, and a natural wooded slope at the back of the plant has been left unchanged. The delivery of filtered water was begun early in 1908. The full capacity of the original filters was reached in 1909, and with the construction of the last ten filters, the entire city of Greater Pittsburg will be supplied with pure drinking water. For our illustration and the particulars upon which the above article is written, we are indebted to the courtesy of the Allis-Chalmers Company and Industrial Progress.



One of the four huge centrifugal pumps each of which can lift 35,000,000 gallons per day against a head of 46 feet. The two suction nozzles are 28 inches and the one discharge nozzle 36 inches in diameter. The impellers are 11 feet 3 inches in diameter.

FILTERED WATER SUPPLY FOR THE CITY OF PITTSBURG.

The coming ocean race from the Lizard to Sandy Hook for the President Taft cup, under the auspices of the Atlantic Yacht Club, recalls to the minds of yachting men the famous schooner race of 1870 over the same course, between the schooner "Cambria," challenger in that year for the "America" cup, and the American schooner "Dauntless." Starting off the Old Head at Kinsale on July 4th, the "Cambria" passed Sandy Hook lightship on July 27th, 1 hour and 17 minutes ahead of the "Dauntless." Although the skippers chose totally different courses and were separated at one time by 15 degrees of latitude, they were only 77 minutes apart after 23 days of sailing.

[The Editor of the Home Laboratory will be glad to receive any suggestions for this department and will pay for them, promptly, if available.]

WANDERING CHEMICALS.

BY PROF. GUSTAVE MICHAUD, COSTA RICA STATE COLLEGE.

To cause two objects to change place, that is, to pass from one vessel into another and *vice versa*, is a trick sometimes done by conjurers. What is new

CONTENTS OF TUBES BEFORE SHAKING.

in the performance described here is the evident non-intervention of the magician, and the possibility of watching the trick closely in full light. The vessels used are two perfectly transparent glass test tubes. Every spectator can see that they contain nothing but the two substances about to change place. One of these is a fluid, transparent, colorless liquid, which fills about one-half of the tube. The other tube contains nothing but a white, opaque powder. Both tubes are given to some skeptical spectators, with the request that they be kept well apart, one tube in each hand, and that the experimenter should remember which of the liquid or solid is kept in the right or left hand. The skeptical person is then ordered to close both tubes with his thumbs, and to shake them. After having complied with this request, he will find that the two substances have apparently changed places; the tube which contained a white, opaque solid now contains a colorless, transparent liquid; and the tube which contained a watery liquid is now filled with a white, opaque, perfectly solid substance.

Some curious and but little known properties of two organic substances are used for this performance. One of them is the property of salol to remain in the surfusion state with such a tenacity (in open vessels, in presence of unfiltered air) and for such a time that no other substance equals it in that respect, except perhaps the metal gallium. Salol is used in medicine for some kinds of intestinal troubles, and is sold at every druggist's. Some ten grammes of it are placed into a clean and dry test tube, care being taken not to leave crystals adhering on the walls of the tube.

CONTENTS OF TUBES AFTER SHAKING.

The chemical is then melted over any flame. (A candle will do, as the fusion point of salol is but 43 deg. Centigrade.) Once liquid, it is heated a trifle over its fusion point, so as to melt any particles of salol left over the liquid. This is then allowed to cool and is ready for the experiment, even two or three hours after being cold. Carrying it to and fro will not cause the crystallization, but vigorous shaking for about ten seconds invariably transforms the liquid into a solid white mass. At the moment of the solidification the cold tube instantaneously becomes hot.

The property of solid camphor to rapidly melt into a liquid compound whenever ground or shaken with solid chloral hydrate is used in the other test tube. The two chemicals must be finely powdered, and the camphor is sprinkled with a few drops of alcohol before being ground. The two white powders look alike and are superposed in the tube, two parts, in volume, of camphor being taken for one of chloral hydrate. The shaking rapidly mixes and liquefies them.

Large tubes or bottles of any thickness can be used when the experiment is made in a hall. The fusion of salol is then produced in a water bath.

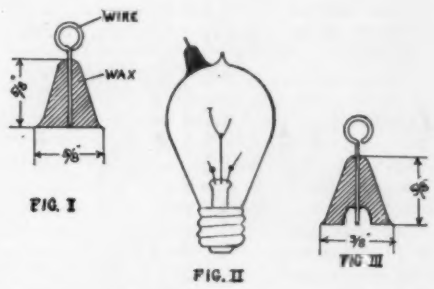
GEISSLER TUBES FROM ELECTRIC LIGHT BULBS.

BY JAMES BAILEY.

Many people have wished to perform experiments with Geissler tubes, but owing to their high cost, have not been able to do so.

By the following simple and inexpensive method anyone who possesses a one-inch, or larger, induction coil can make a very good substitute for a Geissler tube from any of the standard electric light bulbs. Burned-out lamps or lamps in which the filaments are broken give the best results, and can be had for next to nothing. The effect is much better if the filament is broken into fine pieces, as it then does not interfere with the discharge in the bulb. Metal filaments can easily be broken by striking the lamp with the hand, but in carbon lamps the filament is sometimes so tough that it cannot be broken without injuring the bulb.

First make a cone-shaped lump of sealing-wax with a wire or a pin through the center, as shown in Fig. 1. Then heat the bulb enough to make the wax stick to it, and press the cone against the bulb, holding it there until the wax has set. The end of the wire will now press against the glass, as shown in Fig. II. Great care should be taken to get the wire and glass stuck in the wax perfectly air-tight, as the permanence of



GEISSLER TUBE MADE OUT OF AN ELECTRIC LIGHT BULB.

the completed tube depends entirely upon this. When the wax is cool, connect the wire to one terminal of the coil and the socket end to the other terminal. The current will puncture the glass directly in front of the wire and a light bluish glow will fill the bulb. If the wax was stuck to the glass and wire perfectly air-tight no air can leak in through the fine hole made by the spark, and the vacuum will not be destroyed. If air does leak in, the whitish blue color will gradually change to a pinkish glow, and when just the right amount has leaked in, striations will occur as in real Geissler tubes.

Allowing just the right amount of air to leak in is a rather difficult process, but it can be done most simply as follows:

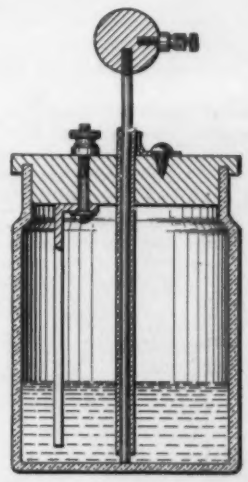
Instead of making a wax cone as in Fig. I., make a bell-shaped piece, as in Fig. III. With a sharp file nick the bulb where the end of the wire will come. The purpose of this nick is to help the spark puncture the glass. It should not be made deep enough to allow any air to enter the bulb. Next stick the wax bell on the bulb so that the end of the wire rests in the nick. Connect to the coil as before, and turn on the current. The spark will jump through the glass and whatever air is in the bell will leak into the bulb. By varying the size of the bell different colored glows may be obtained. The wax bell in Fig. III. shows about the size for the best results with 16-candle-power lamps. Different lamps give different results, so that the exact size of the bell cannot be determined, and striations are more or less a matter of luck. Almost every bulb made as above will show beautiful color effects, each different from the other, and the results are well worth the trouble.

CONSTRUCTION OF A SIMPLE ELECTROLYTIC INTERRUPTER.

BY GEORGE F. WORTS.

The electrolytic current interrupter described here may be used in place of the troublesome vibrator on spark coils. It is to be operated on 50 to 220 volts direct or alternating current. The interruptions obtained with this type of interrupter are very high, being in the neighborhood of 1,000 per second.

The electrolyte and electrodes are contained in a wet battery jar. A wood plug should be turned to fit tightly in the top of the jar, and boiled thoroughly in paraffin to protect it from the acid fumes. A glass tube 6 inches long with an internal diameter of ⅛ inch should be procured, and a hole slightly larger than the external diameter of the tube bored through the center of the wood cover. The tube is held in position by a heavy brass spring pressing against it. For the anode a ⅛-inch round brass rod should be straight-



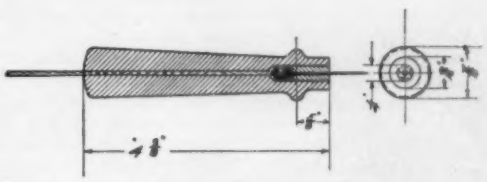
A SIMPLE ELECTROLYTIC INTERRUPTER.

ened, so as to slide very easily through the glass tube. One end of the rod should be squared off, and the other end threaded and a tapped brass ball fitted to it. This weight, by gravitation, feeds the rod into the solution as it is used. One side of the ball should be tapped and fitted with a binding post for connecting purposes. The cathode consists of a lead strip, 6 by 1 by ⅛ inch, suspended in the solution from a machine screw, the threaded end of which terminates in a binding post for connections. To assemble: Fill the jar a third full with a 10 per cent solution of sulphuric or nitric acid; place the wood cover on firmly, lower the glass tube through the hole till it is ⅛ inch from the bottom of the jar, and tighten the spring against it. Then put the rod through the glass tube till it is resting on the bottom of the jar. In use, when the circuit through the apparatus is closed, non-conducting bubbles form and break on the anode, thus interrupting the current. If the interrupter is used on alternating current, the anode will wear down quickly. Connections using alternating current are identically the same as direct, but without regard to polarity, as alternating current constantly reverses poles. If intended for continuous work, the electrolyte should be cooled by running water through a coiled glass tube in the bottom of the jar. This interrupter will successfully operate coils from the small sizes up to the 10-inch size, and is especially desirable in wireless telegraphic transmission, as it aids materially in the production of a penetrating, high-frequency wave.

DEVICE FOR TESTING ELECTRIC WIRING.

BY HOWARD M. NICHOLS.

In testing electric wiring for open circuits, grounds, or short circuits, it is often necessary to skin the insulation from the wires under test, in a number of places, so as to connect them to a magneto or other testing device. The accompanying illustration shows



TESTING NEEDLE FOR INSULATED WIRE.

a device which does away with this necessity; for it contains a sharp needle point, which can be easily pushed through the insulation until it makes a good electrical contact with the wire within. The device is made out of a hard wood handle, bored throughout its whole length to the diameter of flexible lamp cord. The small end is then counterbored to a larger diameter and a plug is made that will drive tightly into the counterbore. The next step is to procure a large-sized sewing needle, which is driven through the plug as shown in the sketch. The eye end of the needle is soldered to a length of lamp cord which is passed

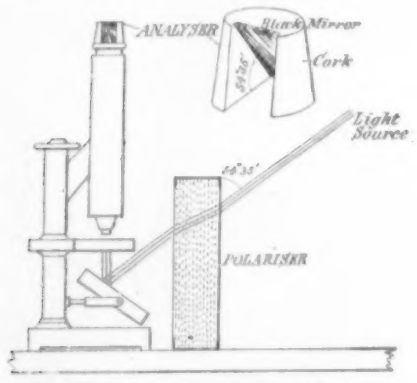
through the handle as shown. The plug is then driven into place and the testing handle is ready for use.

POLARISCOPE ATTACHMENT FOR MICROSCOPES.

Illustrated herewith is a bit of apparatus by means of which polarized light may be used with any microscope without changing the instrument itself. The polarizer consists of one dozen 4 x 5-inch glass negatives which have been thoroughly cleaned and dusted, and are contained in the original box, which has its top and bottom cut out, leaving just enough card around the edges to hold the plates in position.

The analyzer comprises a piece of blackened cork with a wedge-shaped slot cut in one side and a bit of black mirror firmly pressed into position in the slot at the polarizing angle. This rests on the eyepiece of the microscope and may be turned at any angle in the horizontal plane. The black mirror is made of plate glass or cover glass, coated on the back with a mixture of lampblack and shellac varnish or, if more convenient, lampblack and glue. The drawing shows the arrangement of the apparatus with the "Nicols" crossed. A small scale may be attached to the top of the analyzer, so that the angle through which it is turned may be noted.

This scheme may also be applied to a simple, or dissecting, microscope. For simplicity and cheapness, combined with a high degree of efficiency, I do not



MICROSCOPE ARRANGED AS POLARISCOPE.

think this apparatus can be excelled. The pleasure to be derived from its use is infinite.

AN ELECTROPLATING OUTFIT.

WITH PRACTICAL WORKING FORMULÆ.

BY A. J. JAHMAN.

Those who wish to undertake the electro-deposition of metals upon a small scale, whether as a business or for pleasure, will find that the apparatus and utensils here described will meet the ordinary requirements.

The photograph reproduced herewith shows the wooden depositing tank and battery of an outfit in actual use. The battery cells are made exactly as explained on page 445 of the SCIENTIFIC AMERICAN of May 28th, 1910.

The depositing tank is made in the same way, with the exception that the joints are put together with a very thick India-rubber cement of the kind used for repairing tires. The woodwork at the joints is first coated with the cement, both at the grooves and the ends, and is allowed to stand for an hour or two, when it is coated again and put together either with nails driven in diagonally, or with screws. The excess of rubber must be wiped off. In the course of about twenty-four hours the inside of the tank must be coated with a burning-hot solution of paraffin. Unless the paraffin is very hot, it will not penetrate the pores of the wood sufficiently to make it impervious to any of the chemical solutions that the tank may contain. The wood used in making a depositing tank must be well seasoned. If possible use old boards one inch thick, so that when planed the board is not less than seven-eighths of an inch thick, and at all times place cleats across the bottom, so that it will stand clear of the floor or work bench. The rubber cement used for the joints will not be affected by any of the depositing solutions. The tank illustrated measures 5½ inches wide, 12½ inches long, and 11 inches deep. Five such tanks as these should be made, to contain the following cold working solutions, for silver, nickel, brass, copper, and zinc. Gold and alkaline coppering solutions must be worked hot, as will presently be described.

Silver Plating.—Dissolve 2½ ounces silver in a glass flask, by adding 3 ounces nitric acid and 1 ounce distilled water. Heat the flask slightly and place it where the red nitrous fumes will pass off into a flue, or out of doors. When the silver has become dissolved, add a quart of distilled water, stir the mixture well, then add gradually about 5 fluid ounces pure hydrochloric acid, stirring the mixture well with a glass rod. Place the flask in a dark place while the white precipitate (chloride of silver) is settling. Pour off the clear liquid; add another quart of water; stir well; allow it to settle; decant; and wash a third time. This will free the precipitate of impurities formed. Dissolve ½ pound cyanide of potassium in ½ gallon of distilled water. When completely dissolved, add a small quantity at a time to the chloride of silver. Stir this well, and continue to add the cyanide solution until the chloride of silver has only just been dissolved. Allow a little time to elapse between each addition. When all the chloride of silver is dissolved make up the quantity to 2½ gallons with distilled water. This will be the right quantity to fill the wooden tank, with one ounce of silver to the gallon. Let this solution stand for twenty-four hours, so that all dirt will settle, and then pour the clean solution into the tank. The solution is now ready for use.

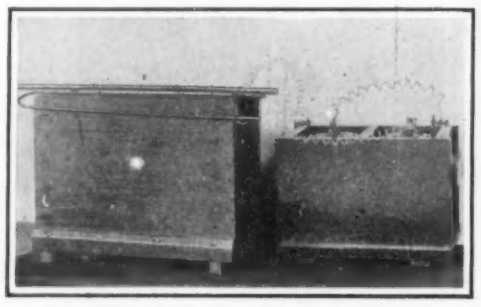
Two sheets of fine silver about 5 inches square must be used for the anodes, suspended by either copper or silver wire hooks upon the copper rod (shown in the illustration) attached to the wire from the carbon of the battery, while from the bent copper rod the articles to be plated must be suspended, this rod being attached to the zincs of the battery. The articles to be plated must be cleaned by boiling them in a strong solution of common washing soda for twenty minutes, rinsing in water, and scouring them individually with a stiff nail brush dipped in pumice powder or brick dust. Articles of German silver, brass, or copper, after scouring and being attached to the slinging wire, must be dipped into a solution of one ounce of nitrate of mercury in a gallon of water. This will give a chemically clean surface and cause the silver to adhere firmly when the deposit takes place in the silver bath. Three or four spoons or forks should be submerged in the plating liquid, quickly, before the anode of silver is inserted. Then the conducting rod may be loaded with as many articles as it will take, inserting both anodes. In the course of 10 or 15 minutes the articles must be removed, rinsed in water, and submitted to the action of a brass wire scratch brush, either by hand or in a scratch-brush lathe, with clean water running upon the article, after which it must be returned to the depositing bath to receive its final deposit, and then be finished by again scratch-brushing, burnishing, and polishing.

Nickel Plating.—The following directions apply to small work, mainly in brass or a similar alloy. Unlike silver plating, the articles must in the first place be polished and finished with a fine surface before plating. The nickel solution is made by dissolving 12 ounces of the double sulphate of nickel and ammonia in 160 ounces distilled water. Filter the solution through absorbent cotton. Use a nickel anode about 4 by 10 inches long. Clean the article in a hot solution of common soda, and scour well with a soft brush and very fine pumice powder. Twist a piece of clean copper wire around one end, dip the article into clean water, and then into a final cleaning solution of 1 ounce cyanide of potassium and 1 gallon water. Only a momentary dip is required to give a chemically clean surface. Then rinse it in clean water and place it in the nickel solution. Deposition takes place at once. Move the article about occasionally. The color of the deposit can be improved by this means.

Copper Plating.—Articles in iron and steel before being nickel plated must be coated with a deposit of copper in an alkaline coppering bath, which can be used either cold or hot. If used hot, an enameled iron boiler will answer the purpose, but the heat must not exceed 130 degrees Fahrenheit for a bath of the formula given. Dissolve ¼ pound sulphate of copper in ½ gallon hot water. Also ½ pound carbonate of potash in 1 quart of water, and about 10 ounces cyanide of potassium in 1 quart water. Add the carbonate of potash solution to the sulphate of copper. Stir the mixture well. Add enough strong liquid ammonia to dissolve the precipitate. Then add gradually the cyanide solution until the blue color disappears. Make up to 2 gallons with distilled water, and after allowing the sediment to subside, pour off the clear liquid into the depositing tank. Have two anodes six inches square, using the second anode according to the number of articles to be plated. The two battery cells above referred to will perform all the work of deposition that this article describes. The cleaning of small iron or steel articles should be done just as described above for silvering. When the articles are coppered they must be scratch-brushed before receiving a deposit of nickel, silver, or gold; then scoured with fine pumice and water. They will then take a fine deposit of these metals.

Gold Plating.—Electro-gilding in a small way is best done by making the gold solution as follows: Dissolve in 1 quart of hot distilled water 1 ounce of cyanide of potassium. Take a small porous pot and fill it about two-thirds full. Place it in the inner vessel of an oatmeal kettle, and pour in this vessel the balance of cyanide solution. Pour a quart of hot water into the outer vessel, and bring it to the boiling point. Take a strip of sheet copper, fix a piece of copper wire to it, and insert this into the porous pot. Attach the wire to the terminal of the zinc of the battery, and a piece of sheet gold to the wire coming from the carbon of the second cell of the battery. Note the weight of the gold. Place the sheet gold in the liquid that surrounds the porous pot, and allow the action of the two cells to continue until 1½ pennyweight has been dissolved from the sheet gold. Remove the porous pot, throw away its contents, use the remaining liquid for the gold depositing, and the piece of sheet gold can be used for the anode. Any article after being well cleaned can be coated with gold in this bath, giving a very rich color. Stale beer is the best liquid to use with a scratch brush in brightening the deposit previous to burnishing. The brass wire brush used should be finer for gold than for silver. The articles after rinsing should be dried in hot boxwood sawdust.

Zinc Plating.—Articles can readily be coated with zinc by using the following solutions (Watts's process): 2½ gallons water, 1 pound cyanide of potassium, 10 ounces of 0.880 ammonia. Place this in one of the tanks. Fill two large porous pots with a plain cyanide solution, consisting of 4 ounces of potassium cyanide to 1 quart water. Place a strip of sheet copper the width of the porous pot in each, and connect the copper with the battery as for gold, using two large clean zinc plates in the ammonia cyanide solution until about 6 ounces of zinc have been dissolved. Remove the porous cells and throw the contents away.



COMPLETE OUTFIT FOR ELECTROPLATING.

Add 5 ounces carbonate of potash, stir until dissolved; let the liquid stand until the dirty matter has subsided, and then siphon off the clear liquid, which is now ready for use. Clean the articles as for silver, using sheet zinc for the anode. A very fine deposit can be obtained by this solution. The articles should be removed occasionally to see that the deposit is going on satisfactorily. If not, scour them slightly with pumice and water, rinse, and return to the bath. When the deposit is complete, the articles may be left dead in color or scratch-brushed.

Brass Plating.—Electro-brassing can be done by the following solution, bearing in mind that metals of the same kind only must be attempted. Wrought iron, cast iron, or steel must be plated separately. Make up the following solution: 4 ounces cyanide of potassium dissolved in half a gallon of warm water, 2¼ pounds carbonate of potash dissolved in ½ gallon water, 2½ ounces acetate of copper dissolved in 1 quart water, 5 ounces sulphate of zinc dissolved in ½ gallon hot water. Let all the solutions be cold before mixing. Add to the acetate of copper solution ½ pint strong water ammonia, 0.880. Just before final mixing, stir this well and add to it the zinc solution, together with another ½ pint strong ammonia. Stir this mixture well, then add the potash solution, and lastly the cyanide solution. Allow this to stand after making the quantity up to four gallons. At the end of about 12 hours pour the clear liquid into the depositing tank, for use. Clean the articles as for silver plating, use the battery coupled in multiple, and a large brass anode, arranged so as to regulate the quantity of surface in the liquid. The exact color can be obtained by raising and lowering the anode. After a quarter of an hour the articles must be removed, rinsed, scratch-brushed, and returned to the bath for the final deposit. In every case in the electro depositing of metals, especially in the gold and brassing, the color can be varied by moving the article to and fro in the solution during deposition. Silver is also affected by this means, the deposit being much whiter when the article is moved.

Pewter, lead, or zinc articles must be electro-coppered previous to silvering or gliding, as well as wrought iron and steel. Special solutions must be made for plating these articles upon a large scale without coppering.

A liquid japan for leather is made as follows: Take four pounds of molasses, half a pound of lamp black, half a pound of sweet oil, and an equal quantity of gum arabic, also half a pint of isinglass. Mix well in 16 pounds of water; apply heat, and when cool add one pint of alcohol.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

GARMENT-FORM.—E. T. PALMENBURG, New York, N. Y. This form is such as is used in stores, show windows, dressmakers' establishments and the like. The aim of the invention is to provide improvements in garment forms, whereby the body of the form can be readily adjusted to assume a desired pose and thus display the garment to the fullest advantage.

HAIR-COMB.—J. H. AKER, East Orange, N. J. The invention relates especially to combs of the type used for dressing the hair, the particular improvement being to provide the comb teeth with channels for the purpose of receiving the dandruff, dust, and various other impurities gleaned from the head by the action of the comb.

Of Interest to Farmers.

MEASURE.—H. C. HARBRIDGE, Margo, Saskatchewan, Canada. The invention is an improvement in dry or liquid measures, which are constructed of one or more sections adjustably received one within the other, whereby the capacity of the measure may be varied. As many farmers do not possess scales, the measure is particularly adapted to their use.

Of General Interest.

REIN-HOLDER.—K. THARRALDSON, Bloomingdale, Cal. This holder is for convenient attachment to the hip-pad of the harness, and is arranged to hold the reins in position along the back of the animal, to allow free lengthwise movement of the reins, to provide sidewise movement thereof and to permit placing the reins conveniently and quickly in position in the holder or removing the reins therefrom.

KILN.—W. DRAYTON, Kachelmacher, Ohio. In this patent the invention has reference to certain improvements in kilns adapted for burning brick or other ceramics, and involves a system whereby a plurality of separate portable kilns are arranged in series to form a continuously moving tunnel in which the bricks are first dried, then burned, and finally cooled.

GUIDE-RACK FOR FIRE-HOSE.—S. B. WILLIS, New York, N. Y. This inventor provides for directing from the ground the stream from a fire hose; a supporting structure upon buildings to guide the nozzle end of a hose pipe when shifted along a building; a permanent hose supporting carriage and operating track therefor disposed in line with the tiers of windows and for shifting the same from window to window, the means provided being operable from the ground.

PIPE.—W. H. STORRS, New York, N. Y. The purpose here is to provide a simple pipe for smoking tobacco, which renders the use of tobacco more healthful, in which the tobacco smoke is cooled before entering the mouthpiece, so that it is rendered more palatable, and in which impurities are removed from the smoke.

MEDICINAL PREPARATION.—C. HEINZINGER, New York, N. Y. The object of this improvement is the provision of a simple and inexpensive lotion for use in various diseases of the eye, which has a pleasant and stimulating action with regard to the tissues, and which is particularly useful for the treatment of trachoma and like diseases.

AIR-COMPRESSOR.—D. R. ALLARD, Arleta, Ore. The main object in the present invention is the provision of means by which the force of the waves of the sea or other body of water may be used to best advantage for compressing air. The same action will take place from the rise and fall of the tide as well as from the force of waves, and hence the invention contemplates a tide power device as well as a wave power device.

SAFE.—R. S. ELLIOTT, Laona, and G. COOK, Gillett, Wis. In this case the invention is an improvement in safes, and the purpose is the provision of a safe especially adapted to resist the insertion of explosives thereinto, and to prevent the insertion of a sufficient amount to cause any damage by exploding the said explosive in detail and in small amounts.

TOY BALE.—A. HIRSCHWITZ and H. MAUDERER, New Orleans, La. This bale can be made in any miniature size and will present the appearance of a cotton bale and thus be desirable in certain sections, especially the cotton growing sections, and will afford in connection with a simple hollow body portion, corrugated to heighten the resemblance to a cotton bale or other complete bale, means for receiving a drawer which can be utilized as a receptacle for confectionery or other suitable merchandise.

PROCESS FOR CONVERTING GLUE.—C. M. ZIMMERMAN, Cincinnati, Ohio. This invention refers to a process for converting or melting glue, and its object is to melt the glue in a very short period of time, thus avoiding the long continued application of dry heat at high temperature, which destroys the fibrous matter of the glue and diminishes its strength.

Hardware and Tools.

NUT-LOCK.—J. C. AUSTIN, New York, N. Y. In this instance the invention has reference to nut-locks for use with ordinary or special bolt nuts and the like, and it relates more particularly to a device of this class having a resiliently expansible body and provided with a threaded bore of varying diameter.

LOCK.—M. H. FARMER, Virden, Ill. One object of the invention is to provide a simple form of locking mechanism which may act in the manner of an ordinary spring lock until the door or other swinging member to which it is applied is shut, when the lock will immediately become "dead" and will require a key to unlock it.

COMBINED MATCH-BOX HOLDER AND CIGAR-CUTTER.—E. OLDENBUSCH, New York, N. Y. The holder is adapted for receiving and protecting the common form of match-box, and it is the location, construction and arrangement of the cutter which embodies the main features of the invention. The cutter is secured to the end of the holder and operates to limit the inward movement of the box and to permit the box to be automatically opened upon insertion of a cigar within the cutter. The last does not interfere with the free opening of the box, and the top of the cigar removed by the cutter falls outside rather than inside the box.

Heating and Lighting.

THERMOSTAT.—W. ENTERLINE, Big Run, Pa. In the present patent the invention has reference to thermostats, and it has for its object the provision of one for use in regulating the flow of gas used to heat water in boilers, which is certain in its operation and one which may be manufactured and repaired at little expense.

HEADLIGHT-BURNER.—C. E. POWERS, Baltimore, Md. The invention relates to headlight burners of the kind adapted to consume oil, the more particular purpose being to provide intermediate the lamp wick and the oil reservoir a member of peculiar shape and offering especial advantages relative to the flow of the oil from the reservoir to the wick.

INVERTED GAS-BURNER.—E. STEIL, No. 14 an der Apostelkirche, Berlin, Germany. The object is to so construct the burner that by the removal of the mixing tube of the Bunsen burner, which is detachable in the usual manner, the gas nozzle is simultaneously moved into such a position that it is readily accessible, which presents the advantage that the clearing of the discharge aperture, which is frequently necessary, can be effected speedily, conveniently and certainly without risk of widening the nozzle aperture.

Household Utilities.

MOP-WRINGER.—W. MONAHAN, Duluth, Minn. The purpose of this improvement is to provide details of construction for a mop that adapt the device for easy connection with the edge portion of a pail or the like, afford reliable support for the wringer from the floor adjacent to the pail, so that lateral strain on the side of the pail is obviated, and further enable the easy, perfect compression of the fibrous mop material, thus removing water from the mop into the pail.

DISINFECTANT-DISTRIBUTER.—J. H. MELVILLE, New York, N. Y. Mr. Melville provides a section of pipe leading from the flushing tank to the water closet, with two openings to the disinfecting chamber, one above the other, to direct a proportion of the water flowing from the tank through the chamber, the last having means thereunder leading to the lower opening in the pipe, there being openings in the bottom of the chamber and bottom of communicating means; a plug closing the opening on the latter, the plug having a screen supported on arms adapted to be brought into close proximity to the opening in the disinfecting chamber.

Machines and Mechanical Devices.

FLUID-EXPANSION PRESS.—I. C. TURLEY, Portsmouth, Ohio. The objects here are; 1. To shift the die cap into and out of position relatively to the die, by turning an expansive medium on and off, for actuating the moving elements so that a single application is sufficient to cover the die and to squeeze within the same the article to be pressed, and that the release of the medium from the press not only restores the die to normal condition, but also removes its cap. 2. To enable the release of the medium to remove the cap by a plurality of motions, first raising the cap clear of the die and then shifting the cap in a lateral direction, the cap performing these movements universely whenever the medium is turned on.

SEPARATOR.—M. L. JONES, Baltimore, Md. In this case the invention has reference to separators for centrally separating materials having a different specific gravity, and partake of rotatable means for separating a material having a lighter specific gravity from a material having a heavier specific gravity, and vice versa.

AUTOMATIC GUN.—G. COLLEONI, New York, N. Y. The main objects here are to provide for maintaining the barrel at a comparatively low temperature; for regulating the quantity and pressure of the gas delivered to the piston; for more effectively transferring cartridges from the feed strip to the breech piece; for bracing the breech block against return movement at the instant of explosion, and for operating the firing pins.

TYPE-WRITER ATTACHMENT.—J. L. MURPHY, Covington, Va. The object here is to provide an attachment which may be easily attached to and detached from a typewriter carriage, and which will support a plurality of superposed strips of paper, and pass them through the typewriter, and which will automatically separate the fair copy from the carbon and deliver it from the front of the machine, and will roll up the copy and retain it in such condition until removed.

CLUTCH MECHANISM.—F. E. SUDDOTH and W. T. S. WEAVER, Omaha, Neb. The object of the improvement is to provide a mechanism especially adapted for automobiles, but equally advantageous for other machinery requiring a variable speed, whereby the relation of the speed of the driven means to the driving means may be varied within the widest possible limits.

Railways and Their Accessories.

METALLIC RAILROAD-TIE.—A. S. WARREN, Batavia, N. Y. The improvement provides a tie having details of construction that prevent it from creeping endwise, or sinking into the roadbed; a further object is to provide effective means for securing track-rails upon the improved cross-ties that may be readily released for track repairs and quickly resecured as occasion may require.

SAFETY-GATE FOR RAILWAY-CARS.—F. T. FILLION, North Platte, Neb. The gate is so constructed that it is held suspended or folded vertically, out of the way, when cars are coupled, but is automatically released, and falls into position across the end of the car platform when the train is broken, that is to say, when the car to which the gate is attached is parted or uncoupled from the next one.

Pertaining to Recreation.

TENNIS-COURT MARKER.—E. A. ROBINSON, Emporia, Kan. This improvement is in devices for marking the lines of tennis courts and other purposes, and the object is to produce an implement which may be used for marking off on the ground the necessary lines, boundaries, etc., of tennis and other courts, and one which can be readily filled with the marking material and which can be used on even surfaces.

Pertaining to Vehicles.

VEHICLE-TOP.—H. C. MARTELL, Flint, Mich. This improvement is in a vehicle top and when the top is extended it forms an efficient covering for the vehicle, and without rendering it difficult to enter into and to depart therefrom, since the usual front bow is dispensed with, and that, when folded, it is compactly stored away in a minimum of space.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions, books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of June 18th, 1910, or will be sent by mail on request.

(12244) C. L. W. asks: That introducing resistance into a circuit reduces the number of amperes flowing is of course plain according to Ohm's law; the amperes being equal to the electromotive force divided by the resistance in ohms. I have also always been under the impression that resistance introduced into a circuit reduced also the effective voltage of the circuit after the current had passed through the said resistance, and that the voltage would fall according as more or less resistance was introduced. The following experiment is therefore hard to explain if this is so. We connected two 110-volt lamps in series on a 220-volt circuit, and in the opened point as shown below, after the current had first passed through the lamps, inserted a large standard voltmeter which read 218 to 220 volts. This was repeated many times, with the greatest precautions as to connections; and also on other sources of supply, and the results were the same in a general way, apparently no drop of any appreciable extent having occurred by the passage of the current through the lamps, although of course the amperes were cut down. What is the explanation of this? Much discussion has arisen over it, and the claim made that the voltage should have been reduced. A. The case of the lamps and the voltmeter as you describe it is no exception to Ohm's law. The resistance was not that of two lamps in series, but of two lamps and a voltmeter which had a resistance of many thousand ohms. The current in amperes became inconsiderable because the resistance was so high, and the voltmeter registered only the voltage. The voltage would be the same as if the lamps had not been in series in the line. No amperes were flowing, or at most a very small fraction of one ampere. The point is this; the voltage at the end of an open circuit is the same as that any where along the circuit. The drop between any two points of a closed circuit is proportional to the resistance between those two points. If the circuit which you show in your figure had been closed the lamps would have lighted, showing that current was flowing, and the voltmeter would then have shown 110 volts drop between the two terminals of each lamp. This is in strict accordance with Ohm's law.

NEW BOOKS, ETC.

THE MANUAL OF STATISTICS. STOCK EXCHANGE HANDBOOK FOR 1910. New York: The Manual of Statistics Company, 1910. 12mo.; 1086 pp. Price, $5.

This volume, which is the thirty-second annual issue, deals with railroad securities, industrial securities, government securities, stock exchange quotations, mining grant and provisions, cotton, money, and information relative to bank and trust companies. It is accompanied by a number of well-executed maps and reference is made easy by the aid of thumb indexes. The book is a model compilation. Rarely have statistics been presented in clearer form. It is an indispensable handbook for the desk for all who are in any way interested in financial matters. There is hardly a person who does not have occasion at one time or another to refer to matters dealing more or less with the statistics of finance.

DANBURY RODD, AVIATOR. By Frederick Palmer. New York: Charles Scribners' Sons, 1910. 12mo.; 310 pp. Price, $1.50.

The average work of fiction devoted to any new science or sport is apt to be rather foolish, and in this respect Danbury Rodd is different from many of its predecessors. There is little question that the aeroplane has come to stay like the automobile, although its field of usefulness is rather more restricted. By far the best story of the eleven is entitled, "A Cure by Aeroplane," in which a railway magnate is kidnapped, taken to his own island in the St. Lawrence River for a rest-cure of a month. The book fairly reeks with gasoline, planes, propellers, trimming planes, and all of the aeroplanist's patter. It is a very readable book and is certain to have an excellent sale. The book was brought out at a psychological moment.

ALTITUDE TABLES. Computed for Intervals of Four Minutes Between the Parallels of Latitude 24 Deg. and 60 Deg. and Parallels of Declination 24 Deg. and 60 Deg. Designed for the Determination of the Position Line at All Hour Angles Without Logarithmic Computation. By Frederick Ball, M.A. London: J. D. Potter, 1909. 8vo.; 43 pp.

THE NEW BAEDEKER. Casual Notes of an Irresponsible Traveler. By Harry Thurston Peck, Ph.D. New York: Dodd, Mead & Co., 1910. 12mo.; 352 pp. Price, $1.50 net.

Now that the "Scientific American Hand Book of Travel" is being purchased so largely by travelers who are thinking of making the voyage, we feel that our readers will be more than interested in knowing of any new books on the subject. If you have ever been to Berlin, Utica, Atlantic City, Brussels, Winnipeg, or any of the places written about by the Irresponsible Traveler; if you ever intend to visit them, or feel any interest in them whatsoever, get a copy of "The New Baedeker." Almost as good as a visit to a place is the Irresponsible Traveler's light, humorous, and yet wonderfully keen and adequate description of it. He tells about a little, out-of-the-way, bygone summer resort called Trenton Falls in a way that makes you vow you will go there. He formulates on paper the essence of Atlantic City. And there are chapters on Liverpool and on Havre which no transatlantic traveler, irresponsible or otherwise, should fail to read.

AMERICAN SCHOOL GARDENS. By M. Louise Greene, M.Pd., Ph.D. New York: Charities Publication Committee, 1910. 12 mo.; 388 pp. Price, $1.25.

This is a publication of the Russell Sage Foundation, and is a splendid example of how well the money of the late financier is being expended for the benefit of humanity. There is nothing which appeals to the imagination more than school gardens, and the writer has taken special pains to visit some of these gardens. The book itself is handsomely gotten up and is admirably adapted to awaken a great interest in "farming" school gardens. There has been need of a manual, as it were, on this important subject, and the author seems to have succeeded in producing a very thorough and scientific work. The bibliography alone is an imposing piece of work, while the list of various seeds, etc., which should be planted shows remarkable knowledge of the subject. The book is unquestionably based on personal observation and is beautifully illustrated with one hundred full-page and small half-tones. When publications of this kind are seen it makes one wish that more millionaires would leave their money with as much discretion as to the means by which it should be expended as did Mr. Sage.

WORK-ACCIDENTS AND THE LAW. By Crystal Eastman. New York: Charities Publication Committee, 1910. 8vo.; 345 pp. Price, $1.50.

This is a part of the Pittsburg Survey. The findings will be published in six volumes. A splendid work of this nature would be impossible were it not for the Russell Sage Foundation. A wisher expenditure of money could hardly have been devised. The study of industrial accidents and their betterment has attracted the attention of the foremost mechanical thinkers and industrial engineers. The editors of the principal technical papers in New

York are banded together to help support the American Museum of Safety. This journal itself is vitally interested in the question of safety for industrial workers, safety on the railroads, and safety at sea. The terrible loss of life and limb which is exacted each year as the industrial toll is something enormous. Each year 700,000 people in the United States, men, women and children, are either killed or maimed by accidents which in most cases are absolutely preventable. There are, of course, certain accidents which may occur in heavy machinery which are the result of defects which cannot make themselves manifest during the progress of manufacture, but in the majority of cases it is possible to either prevent this industrial loss or to at least minimize it so that the damage is not so great. The book before us is one of the finest exponents we have ever seen of this twentieth century humanitarian interest. The illustrations are clear cut and to the point, and are beautifully executed. The illustrations show what a cruel and deceptive looking place is a freight yard at night, with its ghasty white, green and red lights, seemingly inextricably confused. There are illustrations of the dangers which surround the workers in great metallurgical plants, also the great need of guards for the protection of wood-working machinery. The suggestions for prevention are many and are absolutely sound. The United States Steel Corporation has already expended large sums to safeguard their employees, and not from any selfish motive, which is the best thing about the whole situation. Plants all over the country are expending large sums to insure the safety of their employees, not with the idea that they will lessen the damage suits, but from an earnest and honest desire to prevent the shocking industrial waste. It is a small thing to put on the pay envelope, "You are responsible for the safety of others as well as the safety of yourself," but a little sermonette of this kind often bears fruit. The book has one of the best indexes we have ever seen, and the whole book is a great credit to everyone concerned.

THE UNMASKING OF ROBERT-HOUDIN. Together With a Treatise on Handcuff Secrets. By Harry Houdini. London: George Routledge & Sons, Ltd., 1909. 12mo.

The author of this book is a well-known performer on the vaudeville stage. Unlike most men of his calling, he takes a commendable historic and academic interest in it. We venture to say that he probably stands unique in that respect. To perform the enormous amount of research which he has evidently conducted requires not only a love for the art of prestidigitation and magic, but also expert knowledge. Both of these Mr. Houdini possesses to a marked degree. After reading his book there can be no doubt that Robert-Houdin brought very little to the art of conjuring; that, like many conjurers, he was a more or less slavish imitator of those who went before him. Although he makes no pretensions to literary excellence, Mr. Houdini has written a most fascinating book on a fascinating subject. His historical researches he has supplemented with comments on his own performances, which reveal how many of the handcuff tricks which astonish vaudeville spectators of to-day are performed.

OBERAMMERGAU. By Josephine Helena Short. New York: Thomas Y. Crowell & Co., 1910. 16mo.; 184 pp. Price, $1 net.

The object of this book is to give an intimate description of the village where the Passion Play is produced, of the people of the village and their everyday life, with special attention to the characters chosen to take part in the sacred drama. The author has visited the locality at times when it was not thronged with tourists, and has established herself on terms of friendliness with the inhabitants. A helpful *résumé* of the Passion Play is included in the volume, together with other information of value to visitors to Oberammergau and of interest to those who travel only through the medium of books. The writer of this review has also had the great pleasure of seeing the Passion Play, and he can certify to the completeness of the descriptions of both the place and the great religious drama that is enacted therein.

THE WORLD'S BEST BOOKS. Suggestions for the Selection for a Home Library. Cincinnati: The Globe-Wernicke Company, 1909.

The book before us, which consists of some 37 pages luxuriously printed on beautiful paper, contains a carefully classified list of books desirable for the home library, arranged appropriately. Thus we find the one hundred best books of Sir John Lovatt; Canon Farrar's list of twelve, his list of five; lists of best books for boys and girls; the ten best novels; twenty best novels; novels of the West; novels which picture English life; novels of the sea; problem novels; and lastly, Dr. Eliot's five-foot library, and Roosevelt's pigskin library. There is certainly very valuable information condensed in a short space. By the by, the book is sent free of expense.

CAMP COOKING. By Horace Kephart. New York: Outing Publishing Company, 1910. 16mo.; 154 pp. Price, $1.

At last we have a good book on camp cookery. The ordinary cook book would be very useless in a camp, as many of the ingredients could not readily be obtained. The book before us is one of the best cook books that have ever come to this reviewer's table. It gives precisely the information that is required, and in a scientific manner which is greatly to be commended. The recipes are thoroughly common-sense, and include directions for cooking all kinds of dishes which smack of the woods, as deer's brain, moose muffle, vension sausages, jambolaya, "possum," fish baked in clay, and many other equally valuable dishes. Such ordinary articles of food as corn bread are also described. The book is small and will readily slip in the pocket. It will not add a great deal to the weight. The slip cover is very handsome, and the photograph is worthy of better use.

Legal Notices

PATENTS

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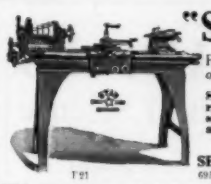

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MANGANESE STEEL RAILS.

(*Concluded from page 516.*)

rails used by the Boston Elevated upon its curves were formed by casting. This is, of course, an expensive process. In fact, this corporation rail costs about $5 per foot for the rails. The ordinary rail costs only about 38 cents per foot, or only 1/3 as much. But even then it is regarded as a good investment, because of the very long life. In the autumn of 1908 the company had in service 475 feet of this rail in addition to three crossing frogs and a number of ordinary frogs. Its experience is certainly worthy of attention. However, if manganese steel can be rolled to advantage, we may expect a still better material at a lower figure. In fact, such rails have been rolled to sell for about $200 per ton; or about $2.50 per foot (about 85-pound section).

Perhaps a considerable portion of the expense of rolling manganese-steel rails is due to the considerable piping to which ingots of this material are subject, requiring thus a large discard or special means of prevention. On the other hand, considerable blow-holes are thought to be infrequent, if they occur at all. This is attributed to the high percentage of substances which have a stronger affinity for oxygen than iron. This will be better understood, perhaps, by considering an analysis of manganese steel:

	From	To
Manganese	0.1100	0.1300
Carbon	0.0100	0.0120
Silicon	0.0025	0.0040
Phosphorus	0.0006	0.0011
Sulphur	0.0002	0.0006
Iron	0.8767	0.8523
	1.0000	1.0000

Some of the difficulties of rolling this metal have been given by Mr. W. S. Potter. When the temperature has fallen as low as about 1,300 deg. F., it becomes apparently inadvisable to continue, not merely because of the great difficulty of making reductions, but more especially because, when air-cooled afterward, the metal will be found to have a coarse structure and to be wanting in some of its desirable qualities. The steel may, however, be restored by reheating and quenching. However, we have then lost that excellence which results from rolling. Consequently, for the usual methods, 1,300 deg. F. is to be regarded as the lower limit. As to the upper limit—it is necessary to avoid burning or cracking, for the reason that then the steel will be apt to crush in the mill. Apparently, the upper limit beyond which it is scarcely safe to go is about 1,875 deg. F. We have then a thermal range of about 575 deg. F. in which to effect the rolling. But a rail ingot in the ordinary American practice has lost about 900 deg. F. by the time it has passed through the finishing rolls. Now it may be that manganese steel may cool somewhat more slowly than the ordinary rail steel. But we cannot expect the difference between 575 deg. and 900 deg. to be thus made up. So that, if we should proceed by the usual methods, we would be unable to secure our desired result. However, manganese steel has been successfully rolled in France, in England, and in the United States.

HAMILTON'S AEROPLANE FLIGHT.

(*Continued from page 521.*)

by Curtiss in his trip down the Hudson—he quickly rose into the air and made a large circle over the island. When he left the shore and started to cross the Lower Bay four or five minutes had elapsed, so that the actual start was made at about 7:40. After flying across the bay and the Kill von Kull, Hamilton struck the line of the Pennsylvania Railroad at South Elizabeth, and followed it practically all the way to Philadelphia. The special train, bearing a white streamer on the roof of the foremost car, soon located him and caught up with

(*Continued on page 528.*)

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Inquiry No. 9099.—Wanted address of manufacturers of machinery for making wire cables.

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Inquiry No. 9120.—Wanted, the address of the Oleal Fuel Feeder Co.

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Inquiry No. 9124.—Wanted, name and address of a company in Germany making a machine to manufacture a cement and asbestos shingle and building lumber

Inquiry No. 9134.—Wanted, a small hydraulic motor, capable of giving about one horse power with a water power of 35 lbs. per square inch.

Inquiry No. 9135.—Wanted, name and address of manufacturers of the Parshall Compressed Air Ice Machine.

Inquiry No. 9136.—Wanted, the name and address of a skunk raising farm.

Inquiry No. 9137.—Wanted, a device that will braid leather strips for horse whips.

Inquiry No. 9138.—Wanted, the address of manufacturers of machines capable of forming a number (12 or more) of pieces of paste about 36 mm. x 32 mm. x 6 mm., made of lead oxide and sulphuric acid, and placing them into a frame having a separate compartment for each piece, the space between each piece and the next being all round 4 mm. The process could be somewhat similar to biscuit making.

Inquiry No. 9139.—Wanted, the name and address of some manufacturer of a coffee mill run by water motor.

Inquiry No. 9140.—Wanted, manufacturers of disc records for gramaphones that use a sapphire point instead of a steel needle.

Inquiry No. 9143.—Wanted, name and address of the manufacturers of an air mattress.

Inquiry No. 9144.—Wanted, manufacturers of machinery for making soda water tubes, commonly known as straws.

Inquiry No. 9145. Wanted, to buy machinery to load blasting caps or detonators.

Inquiry No. 9149.—Wanted, manufacturers of machinery for roasting coffee for small and large industries.

Inquiry No. 9150.—Wanted, manufacturers of machinery for the manufacture of French heels for ladies' shoes.

Inquiry No. 9152.—Wanted, the address of the Graham Safety Lamp Filler and Ventilator.

Inquiry No. 9153.—Wanted, name and address of manufacturers of a knotless clothes line.

Inquiry No. 9155.—Wanted, the address of manufacturers of an electric milking machine.

Inquiry No. 9157.—Wanted, manufacturers of peanut shelling and cleaning machinery.

Inquiry No. 9161.—Wanted, a machine that will grind oranges, pulp and skin into a smooth liquid or cream.

Inquiry No. 9162.—Wanted, addresses of shirt makers in Manhattan, who will make a few shirts of special design.

Inquiry No. 9163.—Wanted, manufacturers of a cradle worked by clock work.

Inquiry No. 9164.—Wanted, manufacturers of a vacuum pump that will exhaust from 300 to 400 c. b. inches of air per stroke and built as light as possible.

Inquiry No. 9166.—Wanted, the address of O. Schurmann Street Sweeper and C. H. Butler Contracting Co.

Inquiry No. 9167.—Wanted, the address of the German Quartz Co.

Inquiry No. 9168.—Wanted, the name of manufacturer making the Morse Eureka Spring Terminal, sometimes called spring clip.

Inquiry No. 9169.—Wanted, the address of the manufacturers of the Hornsby Akroid 85 H. P. Gas Engine.

Inquiry No. 9170.—Wanted, manufacturers of a movable apparatus for the distillation of wood stumps.]

Inquiry No. 9171.—Wanted, to buy puzzles for a mail order house.

Inquiry No. 9172.—Wanted, the address of the Arnold Vacuum or Suction Cleaner.

(*Continued from page 527.*)

him, and for ten or twelve miles he flew directly over the train. Then he dropped behind so that the photographers could catch him. Shortly before North Philadelphia was reached he drew ahead of the train, and, before alighting, he made two large circles above the field that was his destination.

The greater part of the trip Hamilton flew at a comparatively slight elevation—about 200 feet. Even in passing over the city of Trenton he rose to only double this height, as he preferred to take the chance of his motor stopping and of his being obliged to descend rather than to cut down his average speed by rising to a great elevation.

The various cities and towns along the route were passed upon schedule time.

After reaching the field at North Philadelphia and circling about a couple of times Hamilton alighted gracefully at 9:26 A. M., just 1 hour and 50 minutes from the time he started. If a deduction is made for the circling about at the start and finish, the actual time of the flight was about 1 hour and 45 minutes. The airline distance is 74.7 miles from Governor's Island to North Philadelphia, but over the route followed by Hamilton it was 82.9. The average speed, therefore, with the time of the circlings deducted, was 47.37 miles an hour, or 45.22, using the full time. In other words, Hamilton had started from an inaccessible island in New York harbor and traveled to North Philadelphia in considerably less time than one could accomplish this journey by boat to Jersey City and rail to one's destination with a special fast boat and express train at command. The directness of air communication was thus forcibly demonstrated.

After being greeted by Governor Stuart and delivering to him the message, as shown in one of our illustrations, Hamilton refilled his fuel and oil tanks, and started on the return trip at 11:33 A. M. The special three-car train was delayed ten minutes in starting, and despite the fact that the train was driven at the fastest possible speed—80 miles an hour or more—its occupants did not catch sight of Hamilton until 28 minutes after they started, while it was about 10 minutes later before they finally overhauled him, 2 miles beyond Princeton Junction and 39 miles from the start. Thirty-seven miles had been covered by the special in 34 minutes, including a stop of 2 minutes at Bristol caused by an express train being in the way. The train and aeroplane traveled abreast of each other for a while, and finally Hamilton dropped slightly behind. He had covered the first 38 miles of his return journey at the rate of 51.8 miles an hour, thus making the fastest cross-country flight yet accomplished. At the small village of Plainsboro, 41 miles from North Philadelphia, Hamilton again flew over the tracks a thousand feet or more back of the train. The heavy clouds of smoke from the locomotive caused him to seek a higher elevation, and he rose to a height of about 800 feet. Soon after crossing the Raritan River the occupants of the train were surprised to see Hamilton turn off to the right and pass out of view. It seems he mistook the river for the Kill von Kull, and started, of course, toward what he supposed to be Governor's Island. The engine had been missing fire on several cylinders, and it finally was running on but six of its eight. Seeing what appeared to be a fine, smooth field below him, Hamilton decided to alight; but was quite dismayed to find himself in a marsh, from which the machine was dragged out with no little difficulty. In attempting to start, Hamilton again broke his propeller, and was obliged to send to Governor's Island for the only remaining one available. Several hours were consumed in getting this propeller—which, by the way, was the one that Curtiss used at Rheims in the Gordon-Bennett race—but as soon as it arrived Hamilton immediately put it on and started once more, at 6:17 P. M. As the propeller was cracked and had been patched up with sheet tin, Hamilton feared it might break before he could complete his journey. He therefore rose to a considerable height—about 1,500 feet—and made a wide circle over Elizabeth. While above the city the engine again started missing and running on but six cylinders. Fortunately, however, his height was sufficient, so that he just succeeded in making Governor's Island during the course of his long descent. The 19¾ miles air-line distance from South Amboy to the Island was covered in about 23 minutes, and he finally alighted in front of the shed at 6:40 P. M.

In addition to this being probably the fastest cross-country flight ever executed, Hamilton's performance was a spectacular one, since the flight was made over water, cities, and open country. When news was received at New York that he had started on the return trip, thousands of people gathered at the Battery, expecting to see him arrive at Governor's Island at about 1:15 P. M. When word came that he had been forced to alight, the crowd was greatly disappointed. Nevertheless, there was a large crowd still when he finally crossed the Bay and alighted before sundown. The weather was humid and hazy, but the air was altogether calm. Hamilton was disappointed that he was unable to make the return trip without a stop. He would have been able to do this had it not been for motor troubles. As far as the aeroplane itself was concerned, this was well-

(*Continued on page 531.*)

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nigh perfect, but Hamilton suffered from that great bugbear of the aviator, a motor breakdown. The motor does not seem to have been as thoroughly inspected as the rest of the machine, and the aviator has expressed the opinion that some missing piston rings in one or two of the cylinders allowed oil to escape by the piston and foul the spark plugs. There was no interruption in the sparking current supplied by the high-tension Bosch magneto. At any rate, Hamilton's flights showed the possibility of carrying mail and important dispatches, and it is interesting to note that Representative Shepherd of Texas has introduced a bill into Congress calling for the investigation of the Post Office Department into the aeroplane for the purpose of carrying mail. Also, a few days after Hamilton's flight, the French war authorities commanded M. Blériot to carry a message from the camp of Chalons to Paris, which he did promptly in his monoplane without any mishap. During the present week Hamilton is to experiment for the government at Nashville, Tenn., upon the dropping of explosives from his machine. These experiments will be carried on during the maneuvers.

The flights of Curtiss and Hamilton have spurred many budding aviators to attempt in the near future some of the cross-country flights for prizes, and new prizes are being offered almost daily for such feats. We wish to remind such aviators that they stand a chance of winning the SCIENTIFIC AMERICAN Trophy if they send in their entry to us or to the Aero Club of America twenty-four hours in advance. The aviator making the longest cross-country flight this year will win the trophy for 1910.

Emery.

BY WALTER C. GOLD.

There are three qualities of emery used in this country—Naxos or Greek, Turkish, and American.

The Naxos brand is imported from the island of Naxos (Grecian Archipelago), Greece, the mines being controlled by the Grecian government. Naxos emery contains a large percentage of alumina (about 65 per cent). This emery has a most excellent fracture, the grains being very hard and very sharp, and therefore especially adapted for use in grinding wheels. These characteristics prevent its use, to any extent, for polishing purposes, as it neither "breaks down" nor granulates under pressure of the work, as do the other qualities (Turkish and American). An ideal emery for polishing must present new cutting points constantly. The Naxos grains are so hard and sharp that it does not properly granulate; therefore it is not a desirable polishing medium, except for certain special classes of work. Naxos emery, owing to its large percentage of alumina, follows corundum in the scale of hardness.

Good Turkish emery contains anywhere from 15 per cent to 25 per cent oxide of iron (the larger the percentage of oxide of iron, the softer is the emery) and it is used therefore exclusively as a polisher on "hard work." Turkish emery has a good fracture, and is just tough enough to make it ideal for polishing purposes.

American emery contains about 45 per cent oxide of iron, and is therefore the softest emery produced; yet is successfully and largely used for certain classes of "soft work."

Most of the Naxos and Turkish emery brought to this country comes in pieces ranging from the size of a marble up to 25 or 30 pounds in weight. Formerly it was brought over as ballast in ships, but it became such an important commodity commercially, that during the last quarter century it has been transported across the water as regular cargo. Turkish emery is brought to the seaports of Asia Minor in the same primitive fashion which has existed for many years—on the back of camels. There are no up-to-date mining methods. The ore is taken from the surface only, and no attempt is made to follow the emery "leads" when they dip below the surface. Thus their mining methods are thoroughly characteristic of the inhabitants of the entire Turkish empire—crude and antiquated. Emery imported from Asia Minor is branded according to the seaport from which it is shipped, the seaports being Smyrna, Kulluk, and Syra; the railway points are Knyujack, Alden, and Aziziek. The different brands of course vary according to the purity of the emery—the larger the amount of oxide of alumina, the better the quality.

The American emery is mined near Peekskill, New York State. Some very excellent ore has been taken out at that place, but the bulk of the emery is high in oxide of iron, and therefore soft. There is also a small deposit in the State of Kansas, but the deposit is insignificant, and the quality of the emery of an inferior character.

The following are the physical properties of emery: Color, black or blue black; specific gravity, 0.4050 ounce. It is thus placed in scale of hardness: Pure Naxos 8¾, pure Turkish 8½, pure American 8¼ (the diamond being No. 10).

In its manufacture the emery passes through great chilled rolls and crushed. It then passes over screens made from bolting cloth, and from the screens it is packed directly into full kegs holding about 350 pounds; half kegs of about 175 pounds and quarter kegs of about 75 pounds; the number of the emery being determined by the mesh or number of holes in the cloth to the square inch. The principal numbers are as follows: 6, 8, 10, 12, 16, 24, 30, 36, 40, 46, 54, 60, 70, 80, 90, 100, 120, 140, 150, 160, 180, F, FF, FFF, FFFF. The first eleven numbers are what are termed "coarse grain," the second nine are the "fine grain," and the last four are "flours." In addition to these there are still finer flours. These are especially fine, and used principally in optical work.

About 50 per cent of all emery is washed with water and then "blown" with a blower to remove the micaceous associates and other foreign matter. Emery so treated of course costs more to produce, but this treatment results in a pure article—one which will cut more keenly and be more durable than otherwise.

Much improvement has taken place in the manufacture of emery in recent years, the principal innovation being the "concentrating" machine, through the use of which the emery is "mulled." This process also removes the micaceous associates and relieves the emery of low-grade ore.

The consumption of emery in this country, for both grinding wheels and polishing purposes, in 1909 was about 9,000 short tons or 18,000,000 pounds.

Emery is a commodity in the manufacturing world which is absolutely indispensable, and the use of it is constantly increasing. There is no material for polishing purposes which could be successfully substituted, for the reason that it is peculiarly fitted for this work. For polishing purposes corundum is too hard; on the other hand, garnet, quartz, and flint are entirely unfitted—they lack that physical property of toughness which is possessed to a marked degree by emery.

It is stated in the Electrical World that of the 5,000,000 horse-power actually represented by the Niagara Falls, only about 5.5 per cent, or about 270,000 horse-power, has been thus far utilized. Of this, 126,000 horse-power is employed in electrochemical processes, 56,000 horse-power for railway service, 36,400 horse-power for lighting, and 45,500 horse-power for various industrial services. Nearly 125,000 horse-power is transmitted to points more than ten miles from the falls. Of this amount 12,300 horse-power is transmitted over a distance of more than 100 miles, while 33,500 horse-power is transmitted between 75 and 100 miles.

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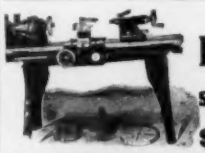

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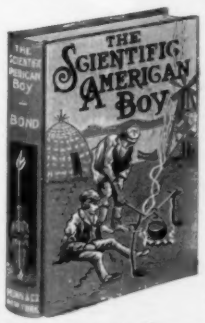

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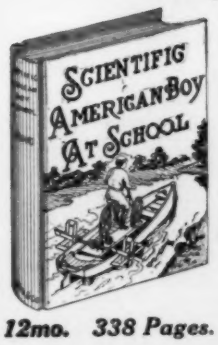

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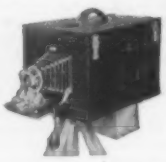

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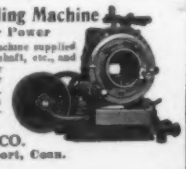

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